5-3805-240-35

TM 5-3805-240-35

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DIRECT AND GENERAL SUPPORT AND DEPOT
MAINTENANCE MANUAL

DITCHING MACHINE: DIESEL ENGINE DRIVEN; WHEEL MOUNTED; LADDER TYPE; 6 FT DEPTH OF CUT, 24 INCH WIDTH OF CUT (PARSONS MDL 624VL)

FSN 3805-050-4638

This copy is a reprint which includes current pages from Changes 2 through 3.

HEADQUARTERS, DEPARTMENT OF THE ARMY

JUNE 1969

D 101.11:

READEX FICHE best copy available

SAFETY PRECAUTIONS

BEFORE OPERATION

Observe all applicable caution and warning notes listed throughout this manual during maintenance or repair of the ditching machine.

Choose clear, level deck for maintenance operations where possible. Keep deck free of grease, oil, ice, and mud to prevent slipping and falling.

Choose lifting devices of adequate capacity and use proper slings to remove or install major components of the ditching machine.

Exhaust all pressure from air system before disconnecting any air lines.

If engine is to be operated in an enclosed area, make sure exhaust gases are piped outside.

Always make certain the digging boom and boom guide assemblies are securely pinned or blocked in position before disconnecting any main hydraulic system fluid lines.

DURING OPERATION

If jacks are used to raise parts of the ditching machine, make sure they rest on solid footing. If jacks are used to remove heavy parts, lower the parts completely for safety.

When blocking up heavy parts, keep the blocking solid and leave an opening for removing subassemblies.

AFTER OPERATION

Stop the engine and stop all other operations when adjusting, cleaning, lubricating, or performing any maintenance operations on the ditching machine.

Changes in force: C 2 and C 3

TM 5-3805-240-35
C 3

CHANGE
No. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *20 May 1974*

Direct and General Support and Depot Maintenance Manual for DITCHING MACHINE: DIESEL ENGINE DRIVEN; WHEEL MOUNTED; LADDER TYPE; 6 FT. DEPTH OF CUT, 24 INCH WIDTH OF CUT (PARSONS MDL 624 VL)

FSN 3805-050-4638

TM 5-3805-240-35, 21 June 1969, is changed as follows:

Page 1-1. Paragraph 1-1*b* is superseded as follows:

b. You can help to improve this manual by calling attention to errors and by recommending improvements. Your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) should be mailed direct to: Commander, US Army Troop Support Command, ATTN: AMSTS-MPP, 4300 Goodfellow Boulevard, St. Louis, MO 63120. A reply will be furnished direct to you.

Page 2-1, table 2-1. Add the following: "Tester, Hydraulic Circuit, FSN 4910-86806871; Use, test hydraulic circuits".

Page 7-1. Paragraph 7-2 is superseded as follows:

7-2. On Vehicle Test and Repair. Refer to paragraph 8-5 for on-vehicle test and repair instructions of the main and steering hydraulic pump.

Page 8-8, paragraph 8-5. Subparagraph *h* is added as follows:

h. On-vehicle test.

(1) The steering element output pressure may be checked by inserting a "T" fitting and pressure gage at either fitting, 29 or 30, figure 2-14, sheet 1. Pressure at these points should be 2000 p.s.i.

(2) The main element output pressure may be checked by inserting a "T" fitting and pressure gage at fitting 22, figure 2-14, sheet 1. Pressure at this point should be 2000 p.s.i.

Page 8-20, paragraph 8-11. Subparagraph *h* is added as follows:

h. On-vehicle test. Hydraulic pressure to the conveyor shift motor is variable, dependent on motor load. Pressure should be 1250 p.s.i. at 4 g.p.m. displacement. This is the same as outlet pressure of the conveyor shift control valve. The pressure may be checked by inserting a "T" fitting and pressure gage at fitting 224, figure 2-14, sheet 3.

Page 8-20, paragraph 8-12. In line 4, change "Pump rotation" to read: "Pump drive".

Page 8-26, paragraph 8-14. Subparagraph *h* is added as follows:

h. On-vehicle test. The output pressure of the crowd drive pump is variable to 1500 p.s.i., maximum, dependent on the demand and load on the crown drive motor. It may be checked by inserting a "T" fitting and pressure gage at fitting 102, figure 2-14, sheet 1.

Paragraph 8-15. Subparagraph *h* is added as follows:

h. On-vehicle test. The crowd drive motor inlet hydraulic pressure is variable, to 1500 p.s.i., maximum, dependent on load demand. Hydraulic fluid flows directly from crowd drive pump to motor; therefore, crowd drive motor inlet pressure will be the same as crowd drive pump outlet pressure.

Page 8-[illegible], paragraph 8-19. Subparagraph *h* is added as follows:

h. On-vehicle test. The outlet pressure of the conveyor drive pump is variable, to a maximum of 2000 p.s.i., dependent on the load demand of the conveyor drive motors. The pressure may be checked by inserting a "T" fitting and pressure gage at the directional control valve fitting 117, figure 2-14, sheet 1.

Page 8-36, paragraph 8-2 Subparagraph *h* is added as follows:

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h. On-vehicle test. The conveyor drive motor inlet pressure may be checked by inserting a "T" fitting and pressure gage at fitting 197, figure 2-14, sheet 3. The pressure will be variable to 2000 p.s.i., maximum, and will be the same as outlet pressure of the conveyor directional control valve.

By Order of the Secretary of the Army:

CREIGHTON W. ABRAMS
General, United States Army
Chief of Staff

Official:
VERNE L. BOWERS
Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-25B (qty rqr block No. 931) Direct and General Support Maintenance requirements for Earth Moving Equipment: Ditchers and Intrenchers.

Changes in force: C 2

TM 5-3805-240-35
*C 2

CHANGE }
No. 2 }

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *22 November 1971*

Direct and General Support and Depot Maintenance Manual

DITCHING MACHINE; DIESEL ENGINE DRIVEN; WHEEL MOUNTED; LADDER TYPE; 6 FT. DEPTH OF CUT, 24 IN. WIDTH OF CUT (PARSONS MODEL 624 VL) FSN 3805-050-4638

TM 5-3805-240-35, 21, June 1969, is changed as follows.

Reverse of Cover Page. Add the following:

WARNING

RADIATION HAZARD

This equipment contains the following *radioactive* item:

TACHOMETER Located on Control Panel

Instructions for safe handling, maintenance, storage, and disposal of this item are contained in TB 750-248.

Page A-1. Appendix A, paragraph A-4, add:

TB 750-248	Instructions for the safe handling, Maintenance, Storage, and Disposal of Radioactive Materiel Managed by USAMECOM.

Page A-1. Appendix A, paragraph A-4; TB ORD 651 in first column is changed to read TB 750-651.

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*This change supersedes C 1, 16 October 1970.

Page 2-16. Figure 2-7 is superseded as follows:

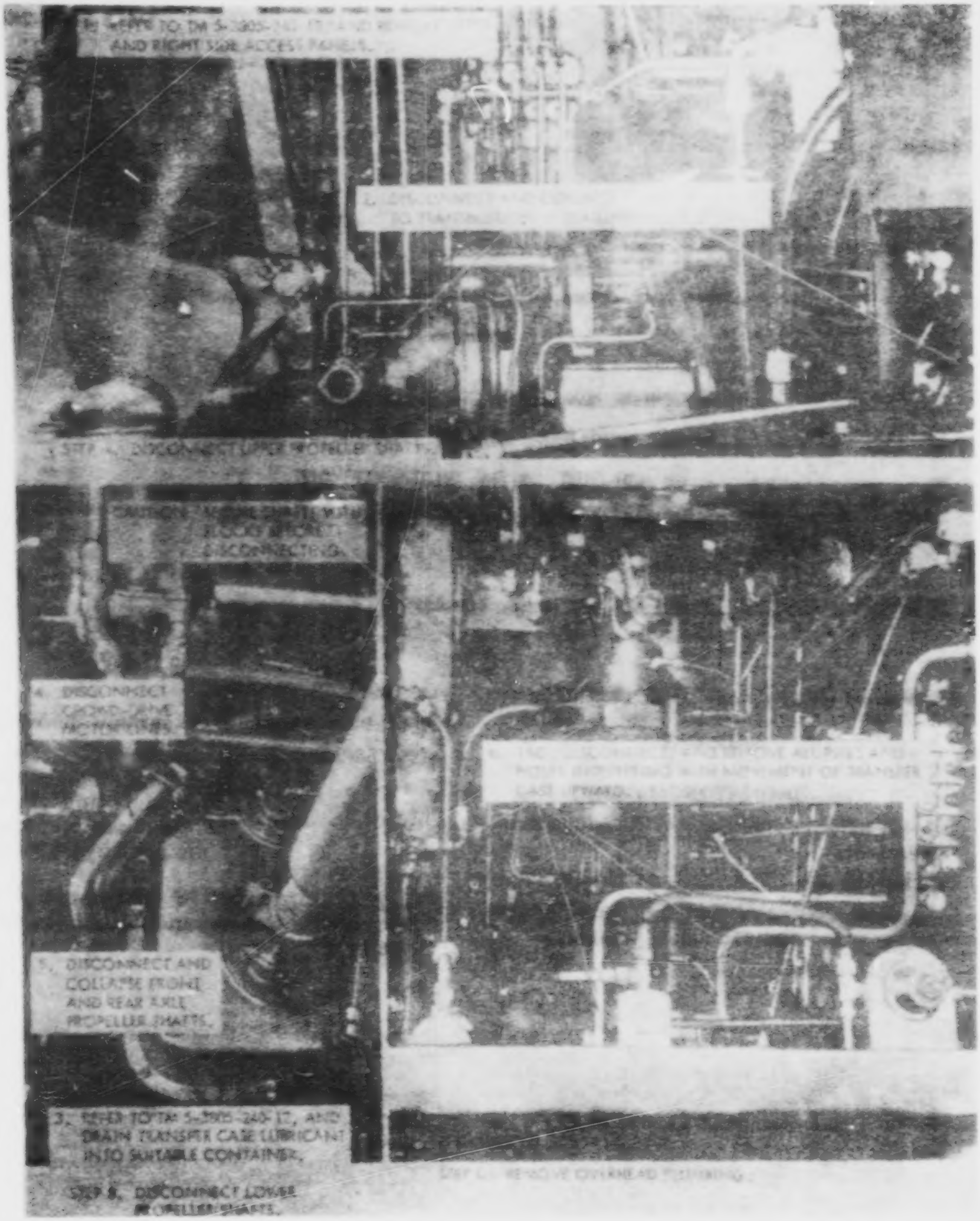

AND RIGHT SIDE ACCESS PANELS.
CAUTION: ... BLOCKS BEFORE DISCONNECTING.
4. DISCONNECT
5. DISCONNECT AND COLLAPSE FRONT AND REAR AXLE PROPELLER SHAFTS.
3. REFER TO TM 5-3805-240-12, AND DRAIN TRANSFER CASE LUBRICANT INTO SUITABLE CONTAINER.
STEP 5. DISCONNECT LOWER PROPELLER SHAFTS.
CASE UPWARD.
REMOVE OVERHEAD PLUMBING.

Figure 2-7. Transfer case removal and installation (Sheet 1 of 2).

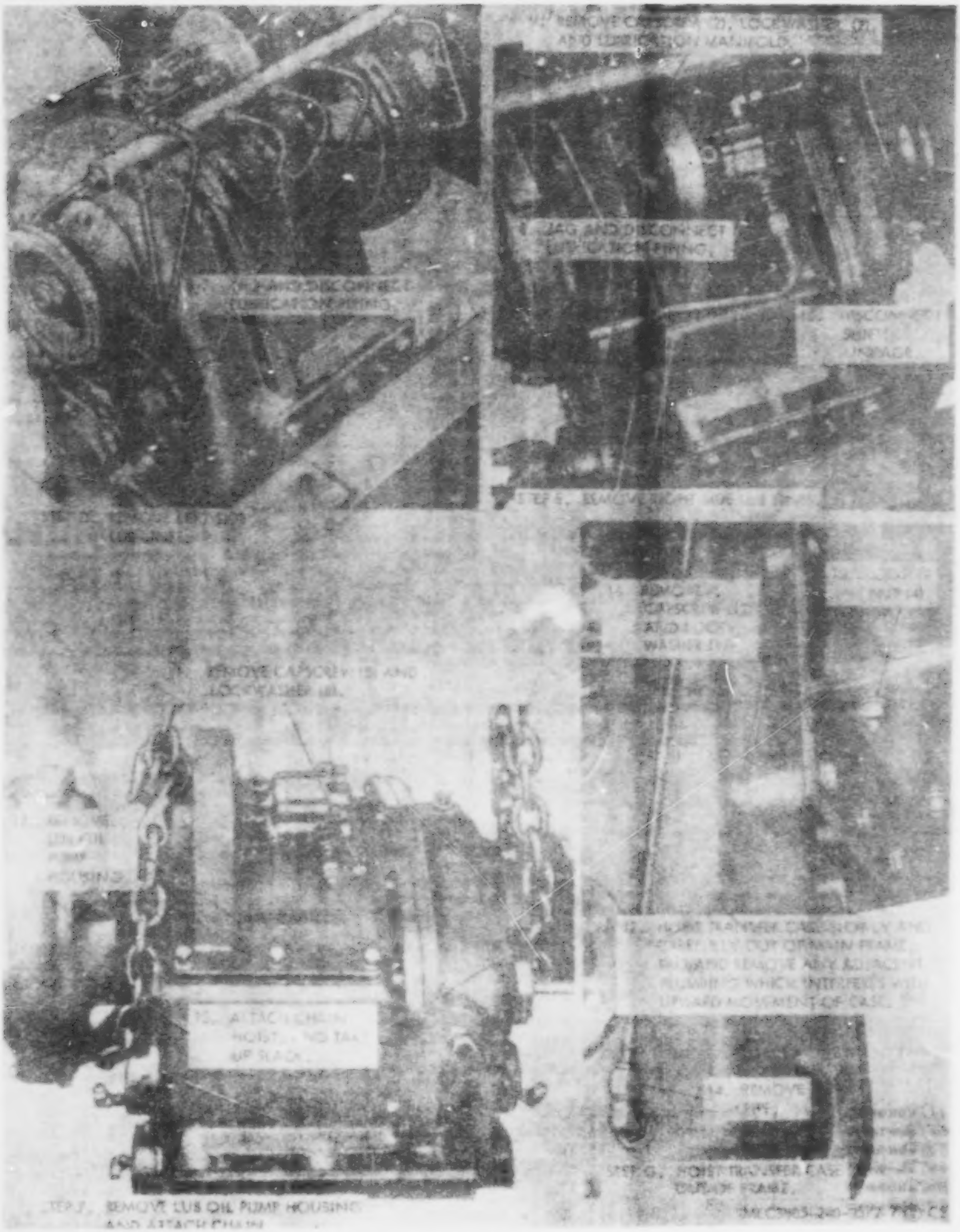
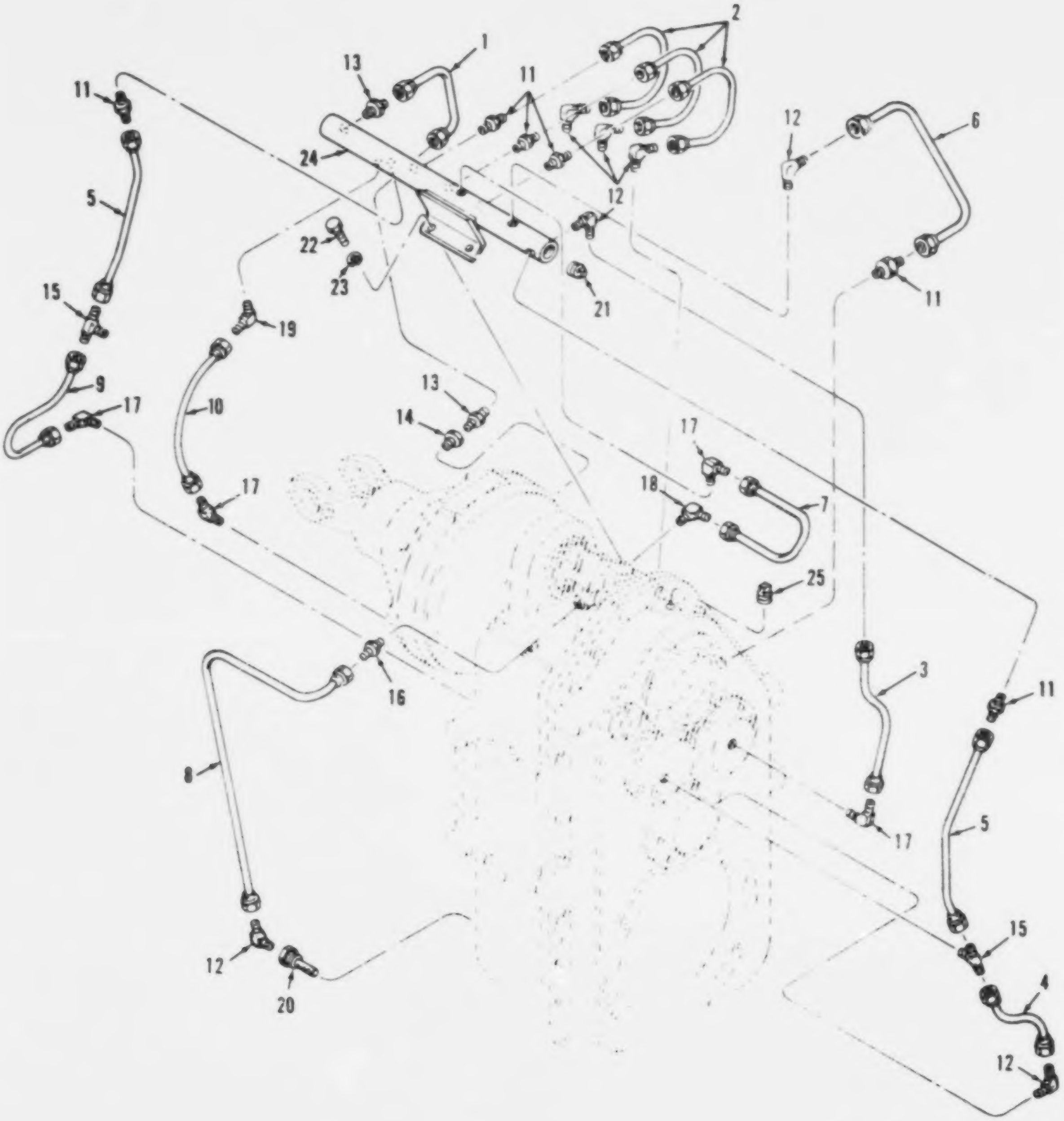

REMOVE CAPSCREW (2), LOCKWASHER (2) AND LUBRICATION MANIFOLD.
TAG AND DISCONNECT LUBRICATION PIPING.
TAG AND DISCONNECT LUBRICATION PIPING.
DISCONNECT SHIFT LINKAGE.
STEP 5.
STEP 6.
REMOVE CAPSCREW (2) AND LOCKWASHER (2).
REMOVE CAPSCREW (8) AND LOCKWASHER (8).
REMOVE LUB OIL PUMP HOUSING.
ATTACH CHAIN HOIST AND TAKE UP SLACK.
STEP 7. REMOVE LUB OIL PUMP HOUSING AND ATTACH CHAIN
HOIST TRANSFER CASE SLOWLY AND CAREFULLY OUT OF MAIN FRAME. TAG AND REMOVE ANY ADJACENT PLUMBING WHICH INTERFERES WITH UPWARD MOVEMENT OF CASE.
REMOVE PIPE.
STEP 8. HOIST TRANSFER CASE OUT OF FRAME.

Figure 2-7. Transfer case, removal and installation (Sheet 2 of 2)

***Page 5-4*. Figure 5-3.** **Figure 5-3 is superseded as follows:**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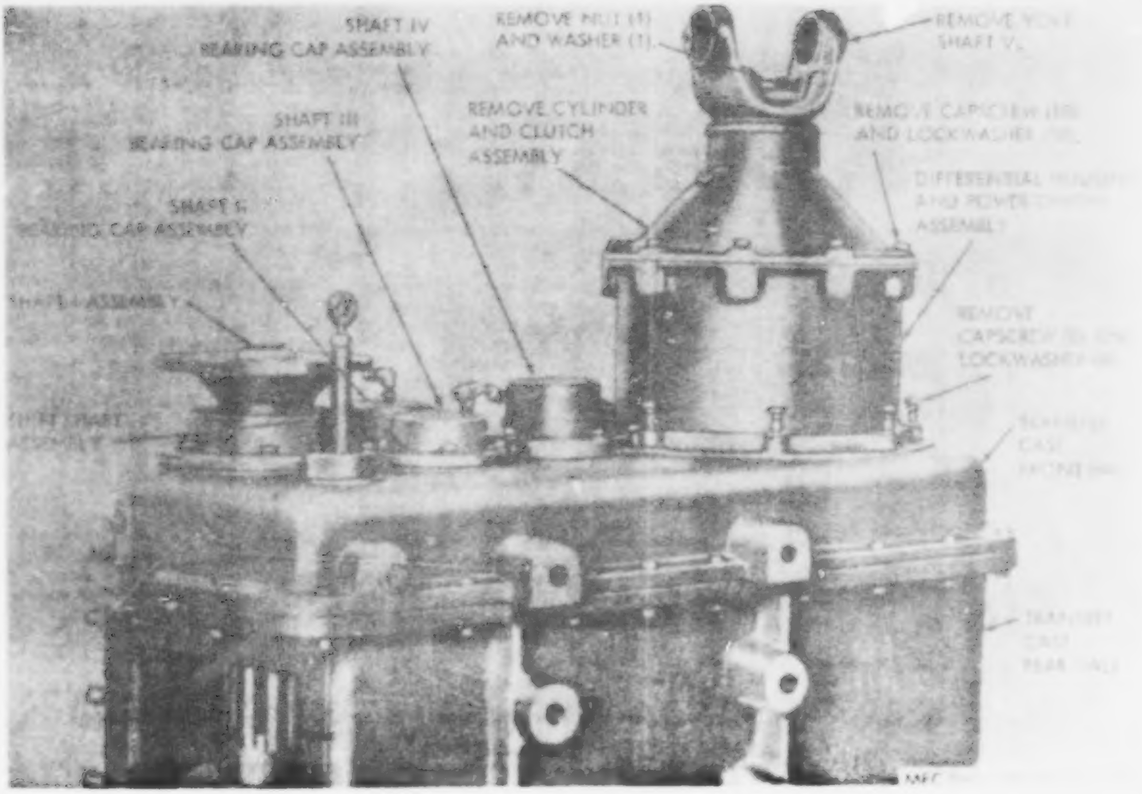
10 Tube assy
11 Connector
12 Elbow
13 Connector
14 Reducer
15 Tee
16 Connector
17 Elbow
18 Elbow
19 Elbow
20 Oil filter screen
21 Plug
22 Screw
23 Washer
24 Junction pipe
25 Pipe plug

MEC 3805-240-35/5-3 C2

Figure 5-3. Transfer case lubrication piping, exploded view.

Page 5-14. Figure 5-17 is superseded as follows:


SHAFT IV
BEARING CAP ASSEMBLY
REMOVE NUT (1)
AND WASHER (1)
REMOVE YOKE
SHAFT V
SHAFT III
BEARING CAP ASSEMBLY
REMOVE CYLINDER
AND CLUTCH
ASSEMBLY
REMOVE CAPSCREW
AND LOCKWASHER
DIFFERENTIAL HOUSING
AND POWER
ASSEMBLY
SHAFT II
BEARING CAP ASSEMBLY
SHAFT I ASSEMBLY
REMOVE
CAPSCREW
LOCKWASHER
SHIFT SHAFT
ASSEMBLY
TRANSFER
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FRONT HALF
TRANSFER
CASE
REAR HALF
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Figure 5-17. Transfer case prepared for front cylinder removal

Page 5-17. Figure 5-20 is superseded as follows:

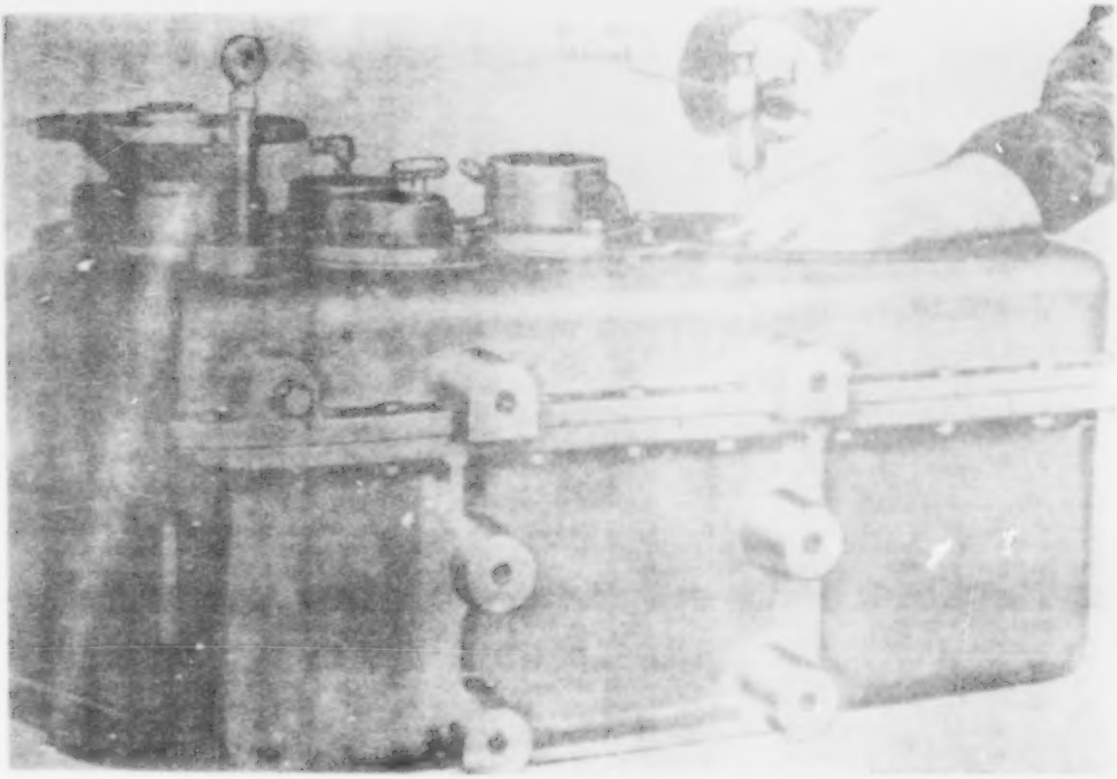


Figure 5-20. Transfer case spacer and bearing removal, Shaft V

Page 5-24. Figure 5-28 is superseded as follows:

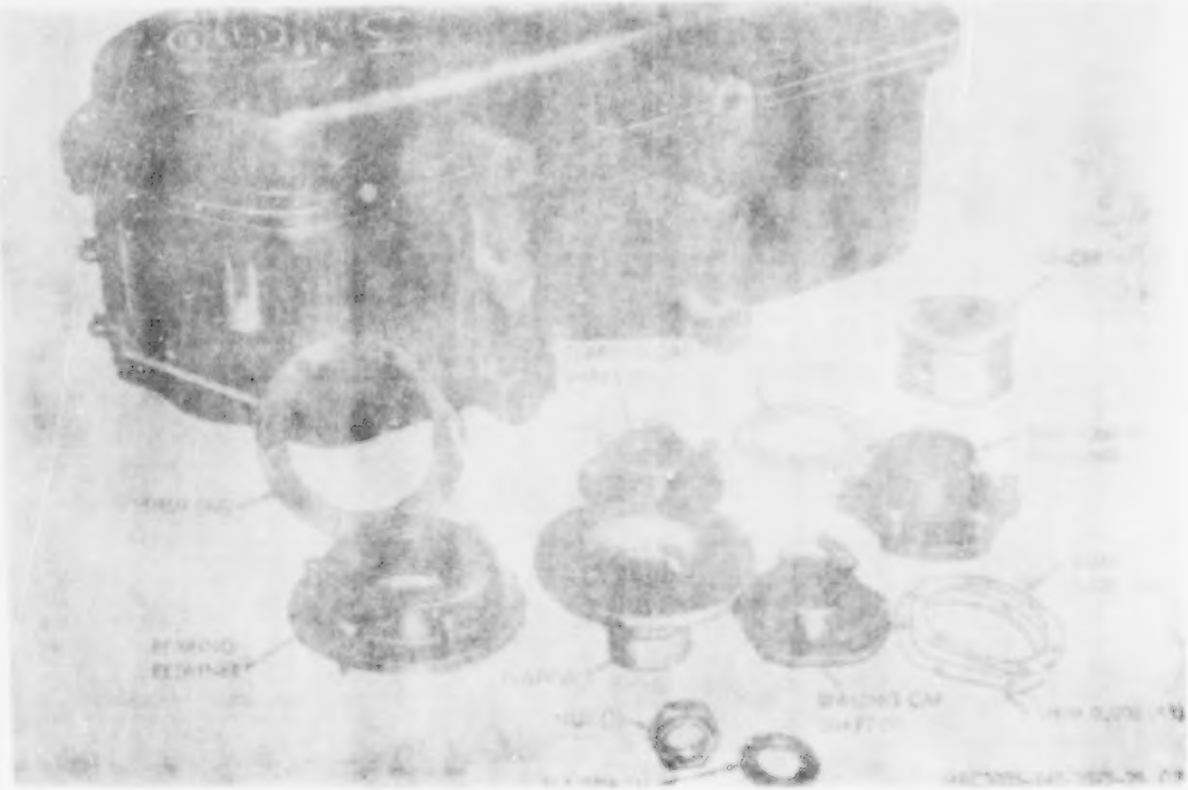
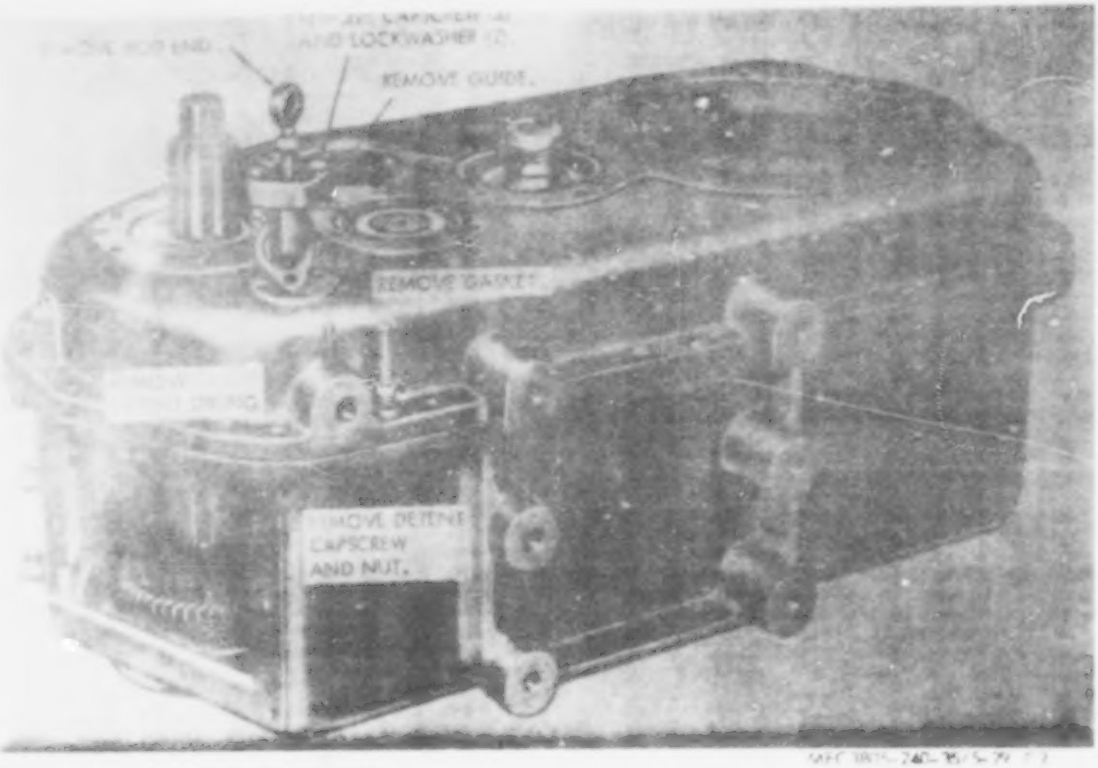

BEARING RETAINER

Figure 5-28. Transfer case front bearing caps, flange, and spacer assemblies.

Page 25. Figure 5-29 is superseded as follows:


REMOVE ROD END.
REMOVE CAPSCREW (2) AND LOCKWASHER (2).
REMOVE GUIDE.
REMOVE GASKET.
REMOVE DETENT SPRING.
REMOVE DETENT CAPSCREW AND NUT.

MEC 3825-240-35/5-29

Figure 5-29. Transfer case shift rod end detent assembly

Page 5-26. Figure 5-30 is superseded as follows:

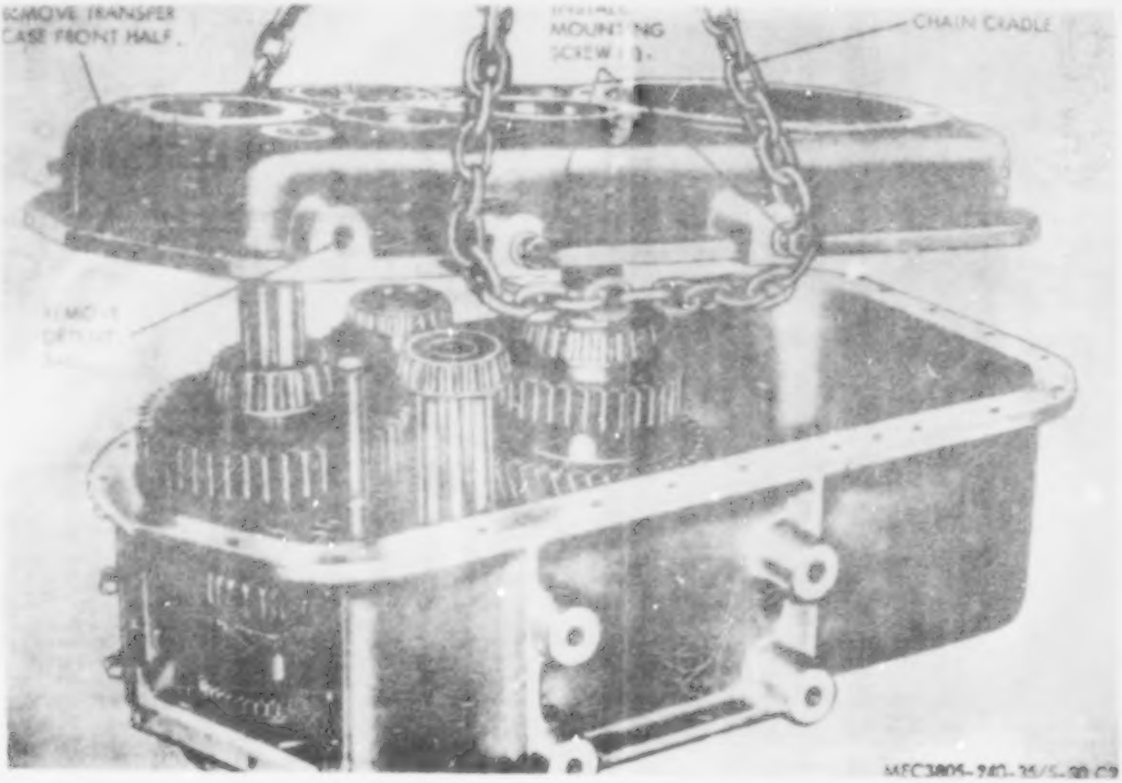
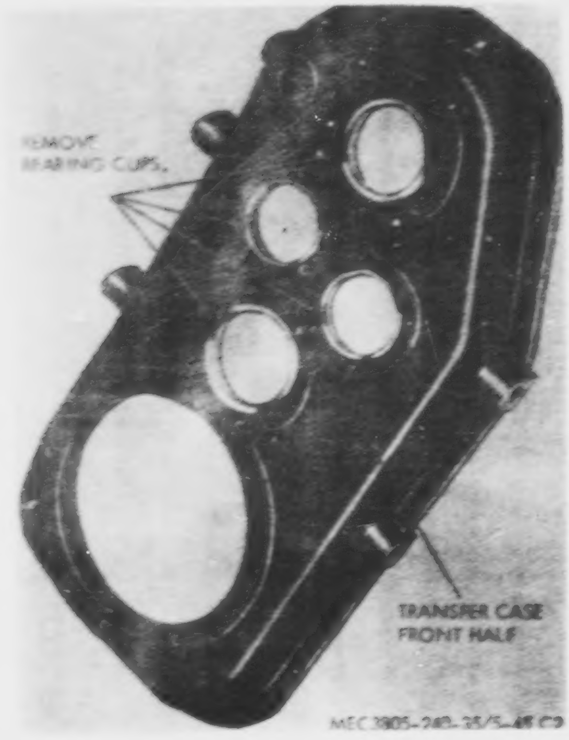

REMOVE TRANSFER CASE FRONT HALF.
INSTALL MOUNTING SCREW (1).
CHAIN CRADLE
REMOVE DETENT
MEC3805-240-35/5-30 C9

Figure 5-30. Transfer case front half, removal.

Page 5-41. Figure 5-45 is superseded as follows:



MEC3805-240-35/5-45 C2

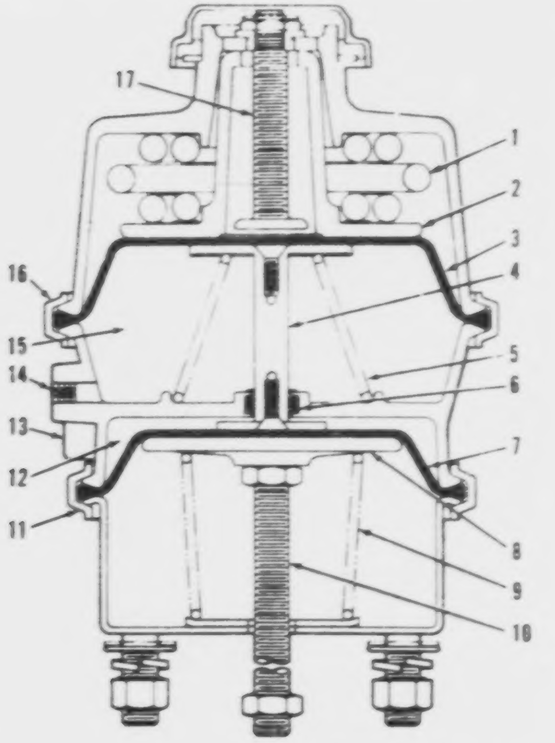
Figure 5-45. Transfer case front half with bearing cups.

Page 6-3. In figure 6-1 change callout 72 to read "Inner axle shaft" and callout 72 to read "Outer axle shaft."

Page 9-20. In figure 9-13 the caption is superseded as follows:

Figure 9-13. Brake chamber, cross-section view (usable on code A.

Figure 9-13A is added as follows:

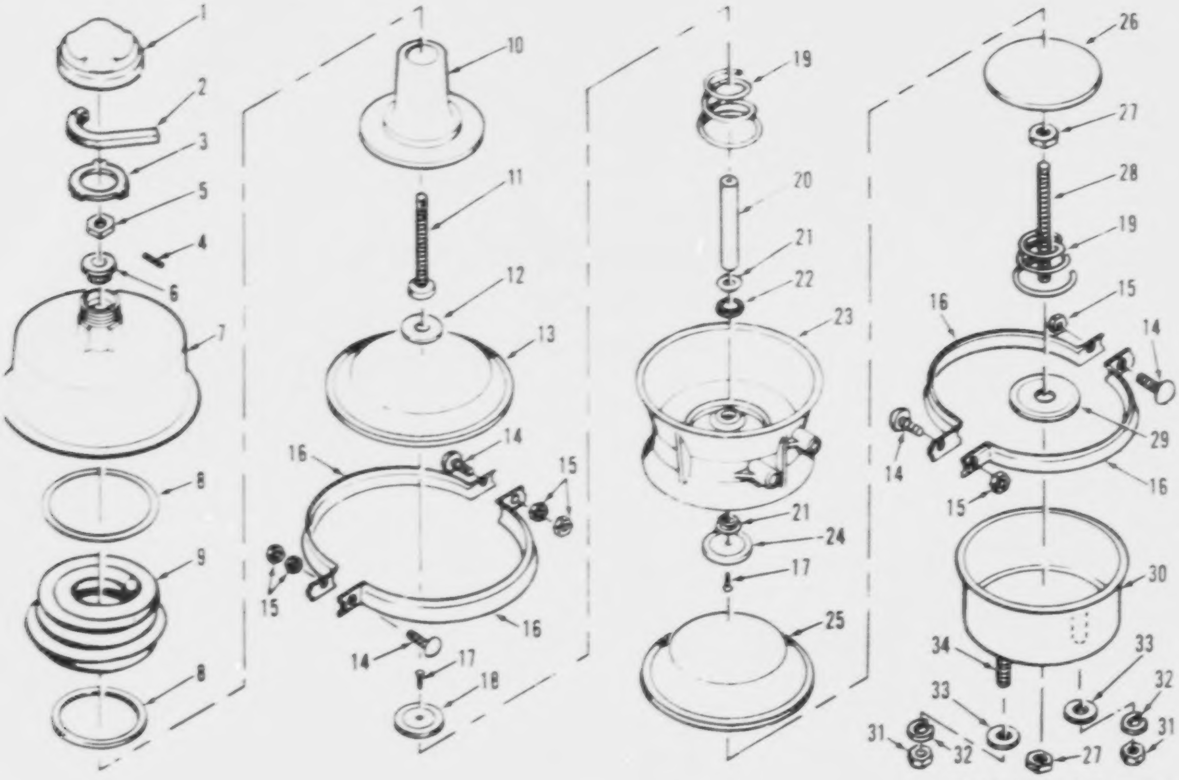


MEC3805-240-35/9-13A C2

1 Spring
2 Piston
3 Diaphragm
4 Pushrod and plate assy
5 Spring
6 Packing
7 Diaphragm
8 Push plate
9 Spring
10 Piston rod
11 Clamp half
12 Service brake chamber
13 Service brake port
14 Spring brake release port
15 Spring brake release chamber
16 Clamp half
17 Bolt

Figure 9-13A. Brake chamber, cross-section view (usable on code B).

Page 9-21 Figure 9-14 is superseded as follows: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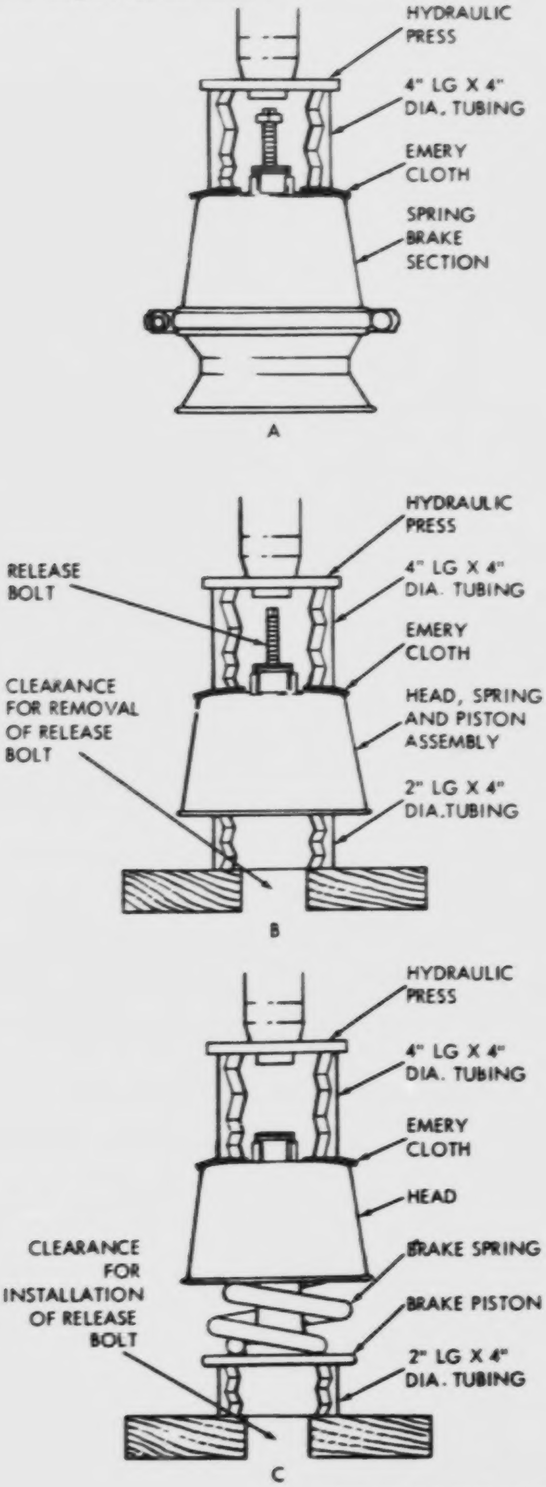
1	Breather cap	7	Chamber	14	Bolt	21	Bushing	28	Piston rod
2	Filter	8	Spring seat	15	Nut	22	Packing	29	Reinforcing plate
3	Filter retainer	9	Spring	16	Clamp half	23	Chamber case	30	Housing
4	Spring pin	10	Piston	17	Screw	24	Push plate	31	Nut
5	Shaft collar	11	Release bolt	18	Push plate	25	Diaphragm	32	Washer
6	Piston insert	12	Cover plate	19	Spring	26	Piston	33	Washer
		13	Diaphragm	20	Pushrod	27	Nut	34	Bolt

Figure 9-14 Brake chamber, exploded view

Page 9-22. **Figure 9-15 is superseded as follows:**


HYDRAULIC PRESS
4" LG X 4" DIA. TUBING
EMERY CLOTH
SPRING BRAKE SECTION
A
HYDRAULIC PRESS
RELEASE BOLT
4" LG X 4" DIA. TUBING
EMERY CLOTH
CLEARANCE FOR REMOVAL OF RELEASE BOLT
HEAD, SPRING AND PISTON ASSEMBLY
2" LG X 4" DIA.TUBING
B
HYDRAULIC PRESS
4" LG X 4" DIA. TUBING
EMERY CLOTH
HEAD
CLEARANCE FOR INSTALLATION OF RELEASE BOLT
BRAKE SPRING
BRAKE PISTON
2" LG X 4" DIA. TUBING
C

MEC3805-240-35/9-15 C2

Figure 9-15. Disassembly and reassembly of brake chamber.

Page 9-28. In paragraph 9-64 change note as follows:

NOTE

Before reassembly, dip the parts of the master cylinder assembly in hydraulic fluid.

Page 9-30. In paragraph 9-65 change note as follows:

NOTE

An air pressure source of 50 psi and hydraulic fluid are required for this test.

After paragraph 9-65*a*, delete the caution.

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army
Chief of Staff.

Official:

VERNE L. BOWERS,
Major General, United States Army,
The Adjutant General.

Distribution:

To be distributed in accordance with DA Form 12-25B, (qty rqr block No. 931) Direct and General Support maintenance requirements for Earth Moving Equipment, Ditchers and Intrenchers.

TECHNICAL MANUAL
No. 5-3805-240-35

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *21 June 1969*

DIRECT AND GENERAL SUPPORT AND DEPOT MAINTENANCE MANUAL

DITCHING MACHINE: DIESEL ENGINE DRIVEN; WHEEL MOUNTED; LADDER TYPE; 6 FT DEPTH OF CUT, 24 INCH WIDTH OF CUT (PARSONS MDL 624VL)

FSN 3805-050-4638

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1–1. Scope

a. These instructions are published for the use of direct and general support and depot maintenance personnel maintaining the Parson Model 624 VL Ditching Machine. They provide information on the maintenance of the equipment, which is beyond the scope of the tools, equipment, personnel, or supplies normally available to using organizations.

b. Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to the Commanding General, U. S. Army Mobility Equipment Command, ATTN: AMSME–MPP, 4300 Goodfellow Boulevard, St. Louis, Mo. 63120.

c. Report all equipment improvement recommendations as prescribed by TM 38–750.

1–2. Record and Report Forms

For record and report forms applicable to direct and general support and depot maintenance, refer to TM 38–750.

Note. Applicable forms, excluding Standard Form 46 (United States Government Motor Vehicles Operator's Identification Card) which is carried by the operator, shall be kept in a canvas bag mounted on equipment.

Section II. DESCRIPTION AND TABULATED DATA

1–3. Description

A general description of the ditching machine, the location and description of the identification and instruction plates, and information on the differences in models are contained in the operator and organizational maintenance manual. Direct and general support and depot repair and maintenance instructions are described in appropriate sections of this manual.

1–4. Tabulated Data

a. General. This paragraph contains all the overhaul data pertinent to direct and general support and depot maintenance personnel. A wiring diagram (fig. 1–2) is also included.

b. Personnel Cab Heater Classification and Rating.

Manufacturer	**Kysor of Byron, Incorporated**
Model	**K708–3**
Volts	**24**
Output	**33,000 Btu (British thermal units)**
Volume	**200 Cfm (Cubic feet per minute)**

c. Front Axle.

Manufacturer	FWD Corporation
Model	2F21P

d. Rear Axle.

Manufacturer	FWD Corporation
Model	3S30P

e. Transfer Case.

Manufacturer	FWD Corporation
Model	L–10110

f. Sprocket Drive Assembly.

Manufacturer	FWD Corporation
Model	108174

g. Nut and Bolt Torque Data.

(1) *Engine.*

(*a*) *Standard nut and bolt specifications.*

Size nut or bolt	Torque ft-lb (foot-pounds)	Size nut or bolt	Torque ft-lb
1/4–20	7–9	9/16–12	90–100
1/4–28	8–10	9/16–18	107–117
5–16–18	13–17	5/8–11	137–147
5/16–24	15–19	5/8–18	168–178
3/8–16	30–35	3/4–10	240–250
3/8–24	35–39	3/4–16	29–300
7/16–14	46–50	7/8–9	410–420
7/16–20	57–61	7/18–14	475–485
1/2–13	71–15	1–8	580–590
1/2–20	83–93	1–14	685–695

(*b*) *Exceptions to standard torque specifications.*

Accessory drive hub-to-camshaft gear bolt.	45–50 ft-lb
Accessory drive disc-to-camshaft gear bolt.	45–50 ft-lb
Air box cover bolt	8–2 ft-lb
Air inlet housing adapter-to-blower housing bolt.	16–20 ft-lb
Air inlet housing-to-adapter bolt.	16–20 ft-lb
Balance weight-to-camshaft gear bolt.	15–18 ft-lb
Balance weight-to-camshaft gear plain nut.	18–22 ft-lb
Balance weight-to-camshaft gear lock nut.	25–30 ft-lb
Balance weight-to-camshaft gear slotted nut.	28–32 ft-lb
Blower drive coupling-to-rotor gear bolt.	20–25 ft-lb
Blower drive assembly and flywheel housing bolts.	25–30 ft-lb
Blower drive support bolts and nuts.	25–30 ft-lb
Blower drive gear hub nut	50–60 ft-lb
Blower end plate-to-cylinder block.	40–45 ft-lb
Blower timing gear-to-rotor shaft bolt.	55–65 ft-lb
Camshaft end bearing bolt	35–40 ft-lb
Camshaft intermediate bearing lock screw.	15–20 ft-lb
Camshaft nut	300–325 ft-lb
Connecting rod nut	60–70 ft-lb
Crankshaft end bolt	290–310 ft-lb
Cylinder head bolt	175–185 ft-lb
Cylinder head nut	175–185 ft-lb
Cylinder head stud	75 ft-lb (min)
Fan hub retaining nut	60–90 ft-lb
Flexplate mounting bolts	96–115 ft-lb
Flywheel housing bolts (3/8–16).	15–20 ft-lb
Flywheel housing bolts (1/2–13).	90–100 ft-lb
Flywheel housing bolts (idler gear hub and spacer).	40–45 ft-lb
Flywheel housing bolts (threaded into plug nuts).	25–30 ft-lb
Flywheel bolts (9/16–18)	180–190 ft-lb
Front accessory drive pulley bolt.	25 ft-lb
Fuel pipe nut	12–15 ft-lb
Fuel pump drive disc nut	55–65 ft-lb
Governor weight shaft bearing retaining bolt.	15–19 ft-lb
Idler gear bearing retaining bolt.	24–29 ft-lb
Idler gear hub and dummy hub bolt.	80–90 ft-lb
Injector clamp bolt	20–25 ft-lb
Injector nut	55–65 ft-lb
Injector filter caps	65–75 ft-lb
Lubricating oil filter center stud.	40–50 ft-lb
Left bank accessory drive gear hub nut.	50–60 ft-lb
Left bank accessory drive support nuts and bolts.	25–30 ft-lb
Main bearing bolt	75 ft-lb (min)
Oil pan bolts (5/16–18)	10–12 ft-lb
Oil pan bolts (3/8–16)	15–20 ft-lb
Rear accessory drive pulley bolt.	35 ft-lb
Rear accessory drive pulley nut.	80–100 ft-lb
Rocker arm bracket bolt	90–100 ft-lb
Rocker shaft bracket bolt	90–100 ft-lb
Tachometer drive cover bolt (7/16–14).	30–35 ft-lb
Tachometer drive cover bolt (1/2–13).	30–35 ft-lb
Tachometer drive shaft	55–65 ft-lb
Variable speed spring lever set screw.	12–15 ft-lb
Water plug (1 3/4–16)	75–100 ft-lb
Water pump impeller nut	45–50 ft-lb

(2) *Transmission/torque converter and power take-off.*

Size	Standard heat-treated bolts and screws	Special heat-treated bolts, screws, Allen-head screws, and self-locking capscrews
1/4–20	6–8 ft-lb	9–11 ft-lb
1/4–28	8–10 ft-lb	10–12 ft-lb
5/16–18	15–18 ft-lb	17–20 ft-lb
5/16–24	17–20 ft-lb	19–23 ft-lb
3/8–16	26–32 ft-lb	36–43 ft-lb
3/8–24	33–40 ft-lb	41–49 ft-lb
7/16–14	42–50 ft-lb	54–65 ft-lb
7/16–20	50–60 ft-lb	64–77 ft-lb
1/2–13	67–80 ft-lb	81–97 ft-lb
1/2–20	83–100 ft-lb	96–115 ft-lb
9/16–12	85–100 ft-lb	103–123 ft-lb
9/16–18	100–120 ft-lb	122–146 ft-lb
5/8–11	117–140 ft-lb	164–192 ft-lb
5/8–18	134–160 ft-lb	193–225 ft-lb
3/4–10	180–210 ft-lb	284–325 ft-lb
3/4–16	215–250 ft-lb	337–385 ft-lb
7/8–9	315–360 ft-lb	490–550 ft-lb
7/8–14	372–425 ft-lb	575–650 ft-lb
1–8	445–500 ft-lb	685–770 ft-lb
1–14	535–600–ft-lb	830–925 ft-lb

Refer to figure 1–1 for bolt locations and torque values.

(3) *Transfer case, axles, and right-angle sprocket drive.*

(*a*) *Standard torque specifications.*

1/4–20	7–9 ft-lb
1/4–28	8–10 ft-lb
5/16–18	15–18 ft-lb
5/16–24	17–20 ft-lb
3/8–16	27–32 ft-lb
3/8–24	32–37 ft-lb
7/16–14	45–52 ft-lb
7/16–20	50–58 ft-lb
1/2–13	70–80 ft-lb
1/2–20	80–90 ft-lb
9/16–12	100–115 ft-lb

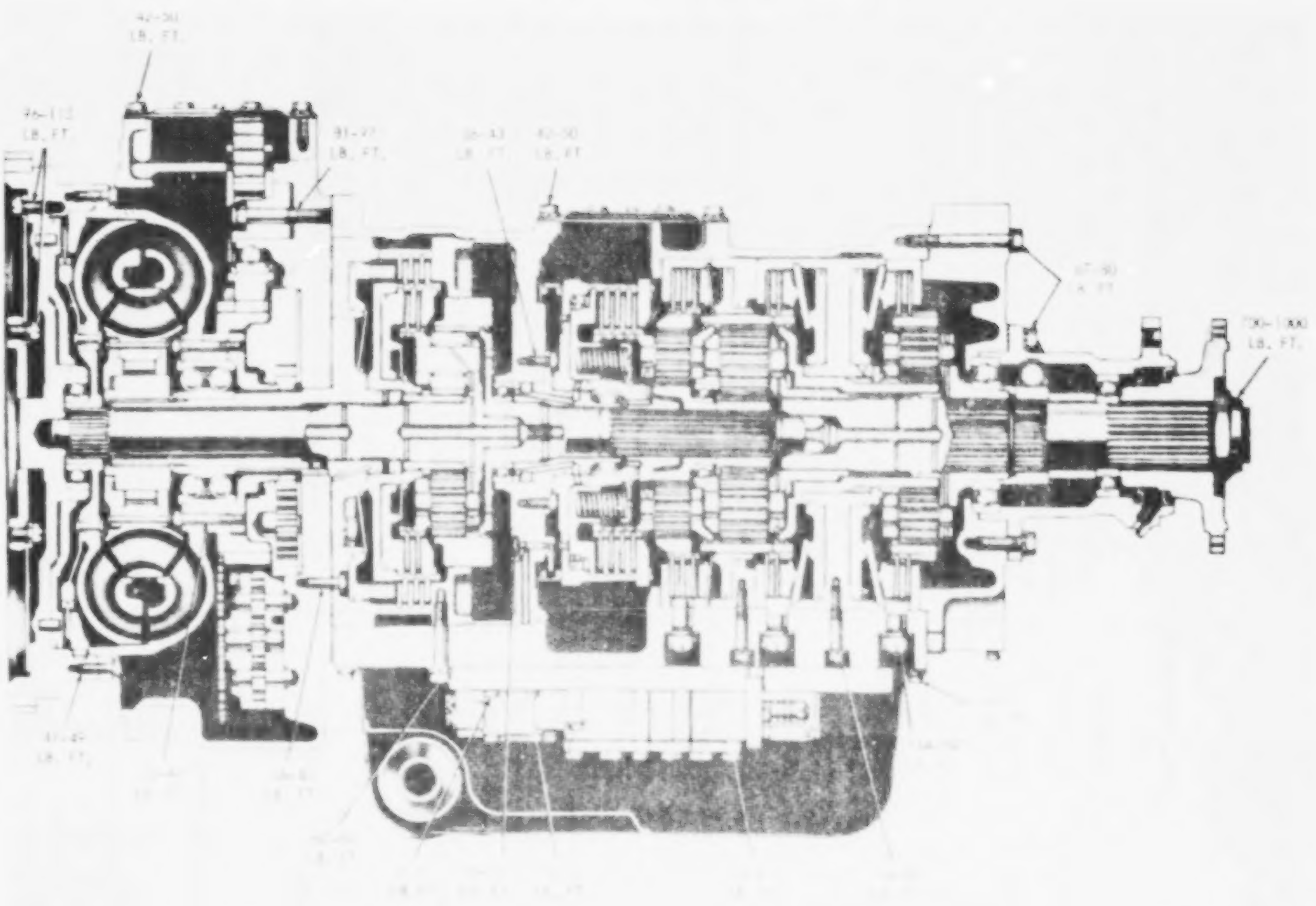
42-50
LB. FT.
96-113
LB. FT.
81-97
LB. FT.
36-43
LB. FT.
42-50
LB. FT.
67-80
LB. FT.
700-1000
LB. FT.
41-49
LB. FT.

Figure 1-1. Transmission/torque converter bolt and capscrew torque values.

9/16-18	110-130 ft-lb
5/8-11	140-160 ft-lb
5/8-18	160-180 ft-lb
3/4-10	250-280 ft-lb
3/4-16	280-310 ft-lb
7/8-9	390-420 ft-lb
7/8-14	430-460 ft-lb
1-8	600-630 ft-lb
1-12	650-680 ft-lb

(*b*) *Transfer case, exceptions to standard torque specifications.*

Bearing cap and retainer capscrews.	20-23 ft-lb
Crowd drive motor mounting screws.	90-100 ft-lb
Cylinder assembly capscrews	60-65 ft-lb
Differential housing capscrews.	90-100 ft-lb
End plate capscrews	41-46 ft-lb
Gear housing capscrews	36-41 ft-lb
Guide screws	20-23 ft-lb
Mounting plate	170-190 ft-lb
Oil pump cover screws	19 ft-lb
Oil pump mounting screws	20-23 ft-lb
Power divider capscrews	80-90 ft-lb
PTO housing capscrews	60-65 ft-lb
Yoke stop nut-clutches	750 ft-lb
Yoke stop nut	900 ft-lb

(*c*) *Axles and right-angle sprocket drive, exceptions to standard torque specifications.*

Axle mounting bolts	525 ft-lb
Bearing cap capscrews	330-350 ft-lb
Differential case capscrews	100-110 ft-lb
Planetary spider capscrews	100-110 ft-lb
Ring-gear capscrews and nuts.	100-110 ft-lb
Socket bearing cap nuts	370-390 ft-lb
Steering arm nuts	370-390 ft-lb
Tie rod arm nuts	370-390 ft-lb
Yoke stop nut (front axle)	750 ft-lb
Yoke stop nut (rear axle)	900 ft-lb
Yoke stop nut (right-angle drive)	350-500 ft-lb

(4) *Power steering gear.*

Cylinder head and bearing cap bolts.	33 ft-lb
Housing cover bolts	112 ft-lb
Pitman arm lock nut	775 ft-lb
Pitman arm lock nut capscrew.	18-20 ft-lb
Relief valve plunger jam nuts.	33 ft-lb
Steering gear cover bolts	167 ft-lb
Steering gear-to-frame bolts	167 ft-lb

(5) *Ditching machine.*

(*a*) *Standard torque specifications.*

1/4-20	3-5 ft-lb
1/4-28	3-5 ft-lb
5/16-18	7-10 ft-lb
5/16-24	9-11 ft-lb
3/8-16	13-17 ft-lb
3/8-24	15-19 ft-lb
7/16-14	23-27 ft-lb
7/16-20	26-30 ft-lb
1/2-13	33-42 ft-lb
1/2-20	42-50 ft-lb
9/16-12	48-56 ft-lb
9/16-18	55-63 ft-lb
5/8-11	72-80 ft-lb
5/8-18	80-90 ft-lb
3/4-10	120-136 ft-lb
3/4-16	136-153 ft-lb

(*b*) *Exceptions to standard torque specifications.*

Conveyor drive motor shaft—end cover screws.	200 ft-lb
Conveyor shift motor,	
end cap-to-body screws	15-17 ft-lb
flange-to-body screws	19-23 ft-lb
Head shaft sprocket lock nuts	225-250 ft-lb
Piston rod nut, boom guide cylinder.	1,595 ft-lb
Piston rod nut, boom hoist cylinder.	250-270 ft-lb
Wiper motor shaft nut	4-6 ft-lb

h. Repair and Replacement Standards. Table 1-1 lists manufacturer's sizes, tolerances, desired clearances, and maximum allowable wear and clearances.

Table 1-1. Repair and Replacement Standards

Component	Manufacturer's dimensions and tolerance in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
ENGINE					
Cylinder Head:					
Cam follower bores	1.0620	1.0630			
Cylinder head					
Flatness (transverse)					0.0040
Flatness (longitudinal)					0.0055
Distance between top deck and fire deck	3.5560	3.5680			3.5360

Table 1-1. Repair and Replacement Standards—Continued

Component	Manufacturer's dimensions and tolerance in inches		Desired clearance			Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum		
Exhaust valve insert counter-bore						
Diameter	1.2600	1.2610				
Depth	0.3380	0.3520				
Concentricity with valve guide						Within 0.003
Exhaust Valve Seat Inserts						
Outside diameter	1.2615	1.2625				
Seat width	3/64	3/32				3/32
Seat runout		0.0020				0.0020
Exhaust valve						
Diameter of head	1.1950	1.2050				
Stem diameter	0.3100	0.3106				
Valve head to cylinder head	Recessed 0.0230	Protruding 0.0060				
Exhaust valve guides						
Height above cylinder head	0.8800	0.8800				0.8800
Inside diameter	0.3125	0.3135				0.3140
Clearance						
Stem-to-guide	0.0020	0.0035				0.0050
Exhaust valve bridge guides						
Height above cylinder head	2.0400	2.0400				
Rocker arms and shafts						
Rocker arm shaft diameter	0.8735	0.8740				
Arm shaft bushing—I.D.	0.8750	0.8760				
Clearance shaft-to-bushing	0.0010	0.0025				0.0040
Cam followers						
Diameter	1.0600	1.0610				
Clearance follower-to-cylinder head	0.0010	0.0030				0.0060
Clearance pin-to-bushing	0.0013	0.0021				0.010 (Horizontal)
Side clearance						
Roller-to-follower	0.0150	0.0230				0.0230
Push Rod Spring						
Free Length—2 5/8 in.						
Out of limits if 172 lbs will compress it to 2 1/8 in.						
Exhaust Valve Spring						
Outside diameter 61/64 in.						
Out of limits if 100 lbs will compress it to 1.397 in.						
Cylinder Block						
Block bore						
Diameter	4.6260	4.6270				4.6290
Out-of-round		0.0010				0.0020
Taper		0.0010				0.0020
Cylinder Liner Counterbore						
Diameter	5.0460	5.0510				
Depth	0.4770	0.4795				
Depth of counterbores (top surface)						
Cylinder head seal strip groove	0.0970	0.1070				

Table 1-1. Repair and Replacement Standards—Continued

Component	Manufacturer's dimensions and tolerance in inches		Desired clearance			Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum		
Depth of counterbores (top surface)—Continued						
Water holes	0.1140	0.1200				
Combination water and oil holes	0.0920	0.0980				
Main bearing bore						
Inside diameter (vertical axis)	4.8120	4.8130				
Cylinder liners						
Outside diameter	4.6250	4.6260				
Inside diameter	4.2495	4.2511				
Clearance—liner-to-block bore		0.0020				0.0025
Out-of-roundness—inside diameter		0.0020				0.0025
Taper—inside diameter		0.0010				0.0020
Depth—liner flange below block	0.0450	0.0500				0.0500
Variation in depth between adjacent liners		0.0010				0.0010
Pistons and Rings						
Piston:						
Height (center-line of bushing-to-top of piston)	3.5130	3.5180				
Diameter:						
At top	4.2230	4.2260				
At skirt (below compression ring grooves to bottom)	4.2428	4.2450				
Clearance—Piston skirt-to liner	0.0045	0.0083				0.0120
Out-of-roundness		0.0005				
Taper		0.0005				
Compression Rings:						
Gap (Top ring)	0.0230	0.0380				0.0600
Gap (No. 2, 3, 4)						
Clearance—ring-to-groove:	0.0180	0.0430				0.0600
Top Ring	0.0040	0.0070				0.0100
No. 2	0.0095	0.0130				0.0220
No. 3	0.0075	0.0110				0.0150
No. 4	0.0055	0.0090				0.0130
Oil Control Rings:						
Gap	0.0080	0.0230				0.0430
Clearance—Ring-to-groove	0.0015	0.0055				0.0080
Connecting rod						
Inside diameter—Upper bushing	1.5015	1.5020				1.5070
Side clearance between rods (normal)	0.0080	0.0160				
Crankshaft						
Journal diameter main bearing	4.4990	4.5000				
Journal diameter connecting rod	2.9990	3.0000				
Journal out-of-round		0.00025				0.0010
Journal taper		0.0005				0.0015
Runout on journals						

Table 1-1. Repair and Replacement Standards—Continued

Component	Manufacturer's dimensions and tolerance in inches		Desired clearance			Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum		
Crankshaft—Continued						
Total indicator reading (mounted on No. 1 and 4 journals) On No. 2 and 3 journals		0.0020**				
Thrust washer thickness	0.1205	0.1220				
End Play	0.0040	0.0110				0.0180
Main bearings						
Bearing Inside Diameter (Vertical Axis)	4.5016	4.5040				
Bearing thickness 90 degrees from parting line	0.1545	0.1652				0.1540 (min)
Clearance bearing-to-journal	0.0016	0.0050				0.0060
Connecting rod bearings						
Bearing inside diameter (vertical axis)	3.0014	3.0034				
Bearing thickness 90 degrees from parting line	0.1238	0.1243				0.1230 (min)
Clearance bearing-to-crankshaft journal	0.0014	0.0044				0.0060
Camshaft						
Shaft diameter at bearings						
Front and rear	1.4970	1.4975				
Center and Intermediate	1.4980	1.4985				
End thrust	0.0040	0.0120				0.0180
Thrust washer thickness	0.1200	0.1220				
Camshaft bearings						
Inside diameter						
Front and rear	1.5000	1.5010				
Center and intermediate	1.5010	1.5030				
Clearance bearing-to-shaft						
Front and rear	0.0025	0.0040				0.0060
Center and intermediate	0.0025	0.0050				0.0090
Outside diameter of bearings						
Front and rear	2.1880	2.1885				
Intermediate	2.1840	2.1860				
Diameter of block bore	2.1875	2.1885				
Clearance bearings-to-block						
Front and rear	0.0010 Tight	0.0005 Loose				
Intermediate	0.0015	0.0045				
Camshaft gears						
Backlash	0.0030	0.0080				0.0100
Idler gear						
Backlash	0.0030	0.0080				0.0100
Crankshaft timing gear						
Backlash	0.0030	0.0080				0.0100
Blower drive gear (and left bank accessory drive gear)						
Gear bushing inside diameter	1.6260	1.6265				
Support hub diameter of bushing	1.6240	1.6250				
Hub-to-gear bushing clearance	0.0010	0.0025				0.0050
Thrust washer thickness	0.2300	0.2500				

Table 1-1. Repair and Replacement Standards—Continued

	Manufacturer's dimensions and tolerance in inches		Desired clearance			Maximum allowable wear and clearance
Component	Minimum	Maximum	Minimum	Maximum		
Blower drive gear (and left bank accessory drive gear)—Continued						
Thrust bearing thickness	0.0590	0.0610				
End thrust	0.0050	0.0100				0.0120
Backlash	0.0030	0.0080				0.0100
Blower						
Backlash—Timing gears	0.0005	0.0025				0.0040
Oil seal (below end plate surface)	0.0020	0.0080				
Oil strainer (below end plate surface)	0.0000	0.0150				
Pin-dowel (projection beyond inside face of front end plate)	0.3800					
Pin-dowel (projection beyond inside face of rear end plate)	0.2700					
Air compressor governor						
Exhaust stem spring						
19/32 ± 1/16 free height						
1/4 height under						
2.7–3.3 lb load						**
Valve spring—						
53/64 approx. free height						
21/64 height under						
7.5–8. 53 oz. load						**
Spring						
1 23/32 approx. free height						
1 7/32 height under						
142–158 lb load						**
Injector follower spring						
1.5040 free height						
1.0280 height under						
70–73 lb load						**
Oil pressure relief valve						
Large spring—						
2.9600 free height						
2.1100 height under						
58.3–60.3 lb load						**
Small spring						
2.5700 free height						
2.0100 height under						
29.3–31.3 lb load						**
Oil pressure regulator spring—						
2.9600 free height						
2.5000 height under						
34.3–36.3 lb load						**
Fuel pump relief valve spring—						
1.9700 free height						
1.1800 height under						
7.1–7.5 lb load						**
TRANSMISSION/TORQUE CONVERTER						
Torque converter and lockup clutch						
Piston face wear						0.0100
Plate *	0.2000	0.2100				0.1900
Back plate face wear						0.0100
Stator thrust washers	0.0230	0.0270				0.0220

Table 1-1. Repair and Replacement Standards—Continued

Component	Manufacturer's dimensions and tolerance in inches		Desired clearance			Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum		
Thrust washer						
ID	4.0100	4.0140				4.0160
Thrust face	0.4780	0.4960				0.4600
Washer-free-wheel side—ID	4.0100	4.0140				4.0180
Stator roller spring 0.8100 free height 0.3840 height under 0.60 ± 0.06 lb load						**
Thrust bearing race	0.0300	0.0320				0.0290
Roller race—OD	3.9990	4.0000				3.9980
Input driven charging oil pump						
Pump assembly						
Gear end clearance						0.0060
Diametral clearance						0.0070
Splitter planetary and clutches						
Piston face wear						0.0100
Piston spring—short 0.0620 free height max						
Thrust washer	0.0920					0.0820
Bushing—ID	2.0625	2.0655				2.0670
Piston spring—long 0.2600 free height max						**
Plate	0.1900	0.1960				0.1700 0.0100***
Plate*	0.1970	0.2010				0.1920 0.0150***
Back plate face wear						0.0100
Minimum clutch pack thickness						0.5520
Plate	0.1580	0.1620				0.1530 0.0150***
Plate*	0.2440	0.2500				0.2240 0.0100***
Minimum clutch pack thickness						1.1460
Splitter planetary gear end play						0.0500
Thrust washer	0.0615					0.0650
Spacer	0.0600					0.0550
Torqmatic retarder and high-range clutch						
Splitter clutch reaction surface face wear						0.0100
Thrust washers	0.0920					0.0820
Bushing—ID	0.9990	1.0020				1.0040
Piston face wear						0.0100
Piston spring 2.1370 free height 1.5000 height under 108 ± 10 lb load						**
Plate	0.1900	0.1960				0.1850 0.0150***
Plate*	0.1970	0.2010				0.1770 0.0100***
Back plate face wear						0.0100
Minimum clutch pack thickness						1.2710
Intermediate-range clutch						
Housing face wear	0.2000	0.2040				0.0100
Plate*						0.1800 0.0100***
Plate	0.2020	0.1970				0.1920 0.0150***
Apply plate face wear						0.0100

Table 1-1. Repair and Replacement Standards—Continued

Component	Manufacturer's dimensions and tolerance in inches		Desired clearance			Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum		
Intermediate range clutch—Continued						
Minimum clutch pack thickness						0.9340
Piston spring						
0.4290 free height, max						**
Intermediate and low-range planetaries						
Intermediate plantary gear end play						0.0500
Thrust washers		0.0615				0.0550
Spacers		0.0600				0.0550
Low planetary gear end play						0.0500
Thrust washers		0.0920				0.0820
Low and reverse-range clutches						
Reaction housing face wear						0.0100
Plate*	0.2000	0.2040				0.1800 0.0100***
Plate	0.1970	0.2020				0.1920 0.0150***
Apply plate face wear						0.1000
Clutch pack running clearance	0.0300	0.0440				0.0540
Piston spring						
0.7800 free height, max						**
Apply plate face wear						0.0100
Plate*	0.2000	0.2040				0.1800 0.0100***
Housing face wear						0.1000
Reverse-range planetary and output drive shaft						
Bushing—ID	1.2500	1.2520				1.2540
Reverse planetary gear end play						0.0500
Thrust washer	0.0615					0.0550
Converter pressure regulator valve and torqmatic retarder control valve						
Retarder valve clearance with body						0.0030
Lube regulator valve clearance with body						0.0040
Converter pressure primary regulator valve clearance with body						0.0040
Converter pressure secondary regulator valve clearance with body						0.0040
Power take-off						
Mating gear backlash	0.0060	0.0100				
Power take-off to transmission gear backlash	0.0060	0.0150				
Piston spring—						
Free height	1.8850	2.1350				
0.7500 height under 115–135 lb load						
Axle differentials						
Side gear thrust washer thickness	0.0540	0.0700				
Differential case: inside radius over spider gears	3.0260	3.0320				
Spider arm diameter	0.9970	0.9980				

Table 1-1. Repair and Replacement Standards—Continued

Component	Manufacturer's dimensions and tolerance in inches		Desired clearance			Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum		
Axle differentials—Continued						
Spider arm roundness		0.0010 TIR	(Total indicator reading)			
Spider arm parallelism		0.0025 TIR				
Spider gear thickness	1.3200	1.3300				
Spider gear: inside diameter	1.0040	1.0060				
Ring gear runout		0.0050				
Ring gear-to-pinion backlash	0.0100 No less than figure etched on back of ring gear	0.0130				
Side gear-to-spider gear: backlash	0.0120	0.0160				
Oil scoop-to-ring gear						just touching
Axle planetaries						
Ring gear-to-planet gear: backlash	0.0060	0.0080				
Sun gear-to-planet gear: backlash	0.0060	0.0080				
Thrust button: thickness	0.2450	0.2550				
Cage ring bearing face: diameter	1.3650	1.3670				
Planet gear thrust washer: thickness	0.0860	0.0890				
Sun gear thrust washer: thickness	0.1570	0.1610				0.0200 TIR
Brake drum: inside diameter	17.2450	17.2550				0.1200 TIR
Brake drum: roundness		0.0100 TIR				
Brake camshaft: roundness at cam points		0.0200 TIR				0.0200 TIR
Brake camshaft: parallelism (cam face-to-shaft)		0.0100				0.0100
Brake lining: thickness	0.7200	0.7800				
Brake shoe anchor pin: diameter	1.2460	1.2480				
Brake shoe roller: diameter	1.2200	1.2800				
Sprocket drive						
Side gear thrust washer: thickness	0.0540	0.0700				
Differential spider arm: diameter	0.8720	0.8730				
Differential spider arm: roundness		0.0010 TIR				
Differential spider arm: parallelism		0.0025 TIR				
Spider gear: thickness	0.9570	0.9670				
Spider thrust-washer: cupping inside radius	2.3210	2.3310				
Spider gear; inside diameter	0.8790	0.8810				
Differential case: inside radius over spider gears	2.3850	2.3910				

Table 1-1. Repair and Replacement Standards—Continued

Component	Manufacturer's dimensions and tolerance in inches		Desired clearance			Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum		
Sprocket Drive—Continued						
Differential case spider journals: inside diameter	2.5940	2.6000				
Ring gear: runout	No less than figure etched on back of ring gear	0.0050				
Pinion-to-ring gear: backlash		0.0130				
Side gear-to-spider gear: backlash		0.0160				
Boom foot bearings						0.0938
Boom foot shaft						0.0625
Boom frame rollers						0.0625
Boom frame shafts						0.0625
Cable sheave bearings						0.0625
Cable sheave shaft						0.0625
Chain idler sprocket bearings						0.0625
Chain idler sprocket shafts						0.0312
Followup scraper rollers						0.0625
Followup scraper shafts						0.0625
Spreader arm bearings						0.0938
Converter pressure spring—						
1.3100 free height						
1.0000 height under						
12.0–14.0 lb load						**
Main pressure regulator spring—						
2.9010 free height						
1.3200 height under						
3.98–4.98 lb load						**
Plug valve spring—						
4.0200 free height						
1.7500 height under						**
34.1–36.1 lb load						
Power Steering valve spring						
8.062 free height						
7.062 height under						
3.7 lb load						
Lockup shift valve spring—						
3.4300 free height						
2.4200 height under						**
1.27–1.31 lb load						
Lube regulator valve spring—						
2.5300 free height						
1.5000 height under						
18.6–20.6 lb load						**
Converter and lube regulator valve spring—						
2.2200 free height						
1.6300 height under						
40.4–49.4 lb load						

Table 1-1. Repair and Replacement Standards—Continued

Converter pressure primary valve spring— 2.1190 free height 1.2500 height under 44.6–45.4 lb load	**
Air System	
·Limiting aid quick release valve spring 1 5/64 approx. free height 41/64 height under 1.8–2.21 lb load	**

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*Groove depth on plate should not be less than 0.0050.
**Replace if not within dimension given.
***Maximum warpage for clutch plates.

i. Engine Run-in Data. Table 1–2 lists time, loads, engine speeds, and inspection procedures.

Table 1-2. Engine Run-In Data

Time	Percent of rated load	Engine speed (RPM)	Inspect
15 min.	15%	1200	Valve clearance (0.013 GO, 0.015 NO-GO with engine hot); injector timing; governor settings.
1 hr.	50%	1800	--
1 hr.	75%	1800	--
30 min.	100%	2100	Repeat above inspections cherk for oil leaks; tighten all external engine capscrews to rated torque.
30 min.	100%	Governed maximum speed	

j. Engine Pressure Inspections. Table 1–3 lists items to be inspected, engine speeds, and acceptable pressures.

Table 1-3. Engine Pressure Inspections

Pressure inspections	Engine speed (in RPM)			
	600	1200	1800	2100
Crankcase pressure, maximum inches of water		0.5	1.1	1.5
Air Intake Restriction, Maximum Inches of Water:				
Dirty air filter element		12.4	25.2	30.0
Clean air filter elemnt		9.0	15.0	18.0
Air Box Pressure, Minimum Inches of Mercury:				
Zero exhaust back pressure (full load)		1.1	3.8	5.0
Maximum exhaust back pressure (full load)		2.6	5.5	8.2
Exhaust Back Pressure, Maximum Inches of Mercury:				
Full load		1.5	3.3	4.0
No load		1.0	2.1	2.6
Cylinder Compression Pressure, Minimum PSI:				
At sea level	425			
At 2,500 feet altitude	395			
At 5,000 feet altitude	364			
At 7,500 feet altitude	340			
At 10,000 feet altitude	315			

k. Four-section Hydraulic Valve Pressure Data. Table 1-4 lists pressure drop and relief valve cracking pressure.

Table 1-4. Control Valve Pressure Data

Pressure drop-Pounds per square inch										
		Section #1		Section #2		Section #3		Section #4		
Flow—GPM	Open center	In Valve (Inlet) and Out Port A or B	Out Valve (Outlet) and In Port A or B	In Valve (Inlet) and Out Port A or B	Out Valve (Outlet) and In Port A or B	In Valve (Inlet) and Out Port A or B	Out Valve (Outlet) and In Port A or B	In Valve (Inlet) and Out Port A or B	Out Valve (Outlet) and In Port A or B	L. H. Cover plate
5	8	12	7	12	7	13	6	13	6	
10	20	24	17	24	16	25	15	26	14	
15	38	40	33	41	31	43	29	44	27	
20	65	60	60	62	55	64	50	66	45	
25	110	85	90	87	85	90	80	93	75	
Cracking Pressure (PSI)						Port A *	Port B 2000	1250	1751	
Flow—GPM						*	8	4	25 max	

*Anti-cavitation check valve: Will pass 5 GPM at 8 PSI Pressure Differential.
Will pass 10 GPM at 19.5 PSI Pressure Differential.
Will pass 15 GPM at 39 PSI Pressure Differential.

l. Electrical Wiring Diagram. Figure 1-2 shows the wiring diagram for this ditching machine.

Figure 1-2. Electrical wiring diagram.

(Located in back of manual)

CHAPTER 2

GENERAL MAINTENANCE INSTRUCTIONS

Section I. SPECIAL TOOLS AND EQUIPMENT

2-1. Special Tools and Equipment

The special tools required to perform direct and general support and depot maintenance on the Parsons 624-VL Ditcher are listed in table 2-1 and illustrated in figures 2-1 and 2-2. References and illustrations indicating the use of these tools are listed in the table.

Table 2-1. Special Tools

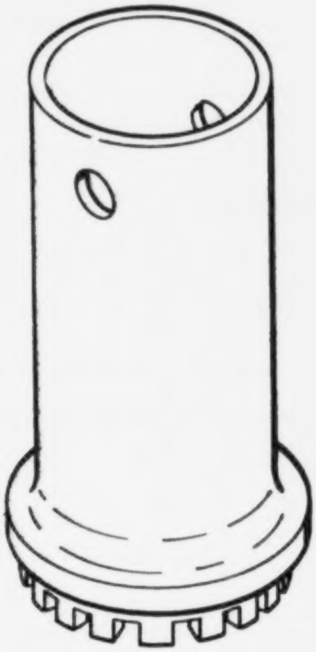
Item	FSN or Part No.	Reference		Use
		Figure	Paragraph	
Skein locknut wrench	FWD No. 75811	2-1	6-2	Remove, adjust and install locknut on axle skeins.
Valve packing seating tool	T-169	2-2	8-18	Packing insertion on conveyor belt directional control valve.

2-2. Specially Designed Tools and Equipment

The specially designed tools and equipment illustrated in figure 4-9 and listed in table 2-2 are for direct and general support and depot maintenance personnel performing major overhaul work on the Parsons 624-VL Ditcher. Tools and equipment listed in table 2-2 are not available for issue but must be fabricated by qualified direct and general support and depot maintenance personnel.

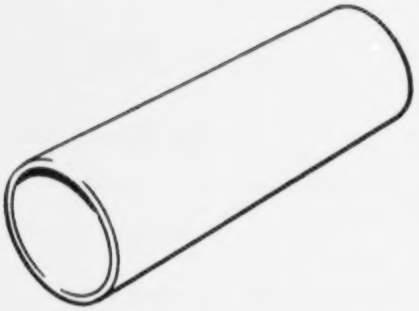
Table 2-2. Specially Designed Tools and Equipment

Item	Reference		Use
	Figure	Paragraph	
Special puller tool	4-9	4-30	Transmission output flange removel.



MEC3805-240-35/2-1

Figure 2–1. Skein locknut wrench.



MEC3805-240-35/2-2

Figure 2–2. Valve packing seating tool.

Section II. TROUBLESHOOTING

2–3. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the ditching machine or any of its components. Each trouble symptom stated is followed by a list of probable causes. The possible remedy recommended is described opposite the probable cause.

2–4. Engine Fails to Crank

Probable cause	Possible remedy
Master switch "off" or transmission not in neutral	Follow correct staring procedure (TM 5–3805–240–12).
Faulty starter button	Replace starter button (TM 5–3805–240–12).
Low battery output	Check the specific gravity of the electrolyte in the battery and recharge the batteries if the reading is low. Check the batteries for loose or corroded terminal connections and clean and tighten connections as necessary. If batteries will not hold charge, replace them (TM 5–3805–240–12).
Internal seizure	Remove transmission/torque converter power take off assembly (para 2–40). Crank engine. If engine turns over seizure is in power take-off assembly. If not, seizure is in engine or transmission. Remove engine and transmission/torque converter (para 2–11), separate and repair whichever components is seized, engine (chap. 3 or transmission/torque converter (chap 4).

2–5. Low Engine Cranking Speed

Probable cause	Possible remedy
Low battery output	Check the specific gravity of the electrolyte in the battery cells and recharge the batteries if the reading is low. Check for loose or corroded battery terminal connection and clean and tighten connections as necessary. If batteries will not hold charge, replace them (TM5–3805–240–12).

Probable cause	Possible remedy
Resistance caused by damaged air compressor	Inspect and replace a damaged air compressor (para 9–3).
Wrong oil	Use the proper oil in the engine crankcase, transmission, transfer case, and hydraulic reservoir (TM 5–3805–240–12).
Loose wiring connections or faulty starter motor	Tighten starter motor and start button wiring connect Repair or replace starter motor if defective (para 3–19 through 3–26 and TM 5–3805–240–12).

2–6. Engine Cranks but Fails to Start

Probable cause	Possible remedy
Engine emergency shutdown valve closed	Push in emergency shutdown knob at instrument panel and open air shutdown valve lever at engine (TM 5–4805–240–12).
No fuel, wrong fuel, or water in tank	Check for closed fuel shut-off valve, low fuel level, or wrong fuel in tank. Open fuel tank and fuel filter and strainer drain cocks and drain off water and residues. Fill tank to proper level (TM 5–3805–240–12).
Air in fuel lines or fuel lines restricted	Perform a fuel flow test to check for air or restrictions. If fuel flow is low, replace fuel filter and strainer elements gaskets. Check for loose connections missing parts, and damaged fuel lines. Tighten connections and replace damaged or missing parts (TM 5–3805–240–12).
Fuel injector racks not in full fuel position	Check engine shut-off cable for binding. Check for binding linkage between governor and fuel injectors (TM 5–3805–240–12). Check governor and injector racks for correct adjustment (para 3–204). Repair or replace controls and linkage and adjust as necessary. Check for frozen or damaged injector.
(In cold weather) engine starting aid inoperative	Check for characteristic ether odor. Replace engine starting aid cylinder if empty. Check for damaged control cable and valve. Check for damaged or loosly connected tubing. Replace damaged parts and tighten loose connections (TM 5–3805–240–12).
Low engine compression	Check for sticking, improperly adjusted, or burned exhaust valves (para 3–75). Clean, replace, or adjust valves as necessary. Inspect piston compression rings through air box covers. Overhaul engine if rings are excessively worn or damaged. Remove radiator cap and check for appearance of gases. If gases are present, check for damaged cylinder head gaskets. If gaskets are undamaged, remove engine (para 2–40) and pressure-test block to check for cracks (para 3–198). Check the blower for proper operation. Repair or replace the blower if necessary (para 3–57).
Faulty fuel pump, or fuel injectors	Check fuel pump lift and overhaul defective pump (para 3–37). Inspect fuel injectors for faulty operation and replace if defective. Test for faulty injectors (para 3–181).
(Hot weather) high fuel return temperature	Disconnect the fuel return line and check the return fuel temperature (TM 5–3805–240–12). If over 150°F, move the ditcher into shade and permit the fuel to cool.

2–7. Engine Stalls Frequently or Runs Unevenly

Probable cause	Possible remedy
Excessively cool engine	Warm up engine properly before operation. Check the water temperature gage during operation. If the temperature falls below 165°F, check the engine thermostats for proper operation and replace if defective (TM 5–3805–240–12).
Insufficient fuel	See the troubleshooting instructions in paragraph 2–6.
Low compression	See the troubleshooting instructions in paragraph 2–6.
Governor instability	Check for binding governor linkages and for faulty governor adjustment (TM 5–3805–240–12). Clean and adjust as necessary. If difficulty persists, overhaul the governor (para 3–29).

2-8. Insufficient Power (Low Pull or Load Capacity

Probable cause	Possible remedy
Incorrect engine adjustment	Check for proper fuel injector timing and exhaust valve clearance (para 3-203 and 3-204). Inspect the engine timing gear train for improper timing. Adjust as necessary (para 3-131).
Insufficient fuel	See the troubleshooting instructions in paragraph 2-6.
Insufficient engine air	Check air restriction indicator. Clean air filter element if indicated. Check the air blower intake, for obstructions (TM 5-3805-240-12). Inspect for high exhaust back pressure and replace faulty exhaust pipes, tail pipes, or mufflers (TM 5-3805-240-12). Remove engine air box covers (para 3-92) and inspect cylinder liner ports. If more than half plugged, clean ports.
Low transmission oil level or wrong oil	Fill transmission to proper level with correct oil (TM 5-3805-240-12).
Transmission clutch slippage	Check the torque converter oil pressure gage for correct operating pressure. If low, place the transmission/torque converter inline filter element (TM 5-3805-240-12). Check the torque converter and transmission hoses for kink damage, and leaky connections. Tighten connections or replace damaged parts (TM 5-3805-240-12). Clean or replace the oil screen (TM 5-3805-240-12). Check for torque converter inlet and outlet pressures (para 4-27) and repair or replace faulty torque converter charging pump (para 4-30, 4-37) or pressure regulating valve (para 4-30, 4-45). Pressure test the transmission clutches for leakage (para 4-27). Disassemble transmission (para 4-30) and check for damaged clutch discs. Replace damaged elements if necessary.
Torque converter defective	Check the torque converter oil temperature gage, if the gage reading is high, see the troubleshooting instructions in paragraph 2-23.
Defective engine-powered rear-mounted attachments	Inspect bucket line and drive components for damage or defects which could overload engine. Repair as required (para 14-17).

2-9. Engine Detonation

Probable cause	Possible remedy
Oil in engine air box	Clean the air box and drains. Remove the air inlet housing and inspect for oil radiating away from the blower shaft while engine is running TM 3805-240-12). If oil seals leak, overhaul blower (para 3-58). Check for damaged blower-to-cylinder block gasket. Replace gasket.
Low engine operating temperature	See the troubleshooting instructions in paragraph 2-7.
Faulty engine tune-up or defective injectors.	Check the injector timing and exhaust valve clearance (para 3-203 and 3-204). Adjust as necessary. Check for defective injectors (para 3-181). Replace faulty injectors.

2-10. High Engine Lubrication Oil Consumption

Probable cause	Possible remedy
External lubricating oil leaks	Inspect the engine components for signs of oil leakage. Check the oil pan for loose drain plug, cracks, or other damage. Tighten loose hose connections and replace damaged hoses (TM 5-3805-240-12). Replace defective gaskets and oil seals. Test for excessive crankcase pressure (para 3-199). If crankcase pressure is excessive, follow the trouble-shooting instructions in paragraph 2-11. Clean the engine air box and drains.
Internal lubricating oil leaks.	Remove some coolant at the radiator filler and inspect for signs of oil contamination. If oil is found, replace the engine oil cooler core (para 3-192) and flush and clean the cooling system. Remove the air inlet housing (TM 5-3805-240-12) and inspect the blower end plates with the engine running. If Oil is on the end plates radiating away from the oil seals, overhaul the blower (para 3-58).

Probable cause	Possible remedy
Ditcher operated on excessive slopes	Restrict slope operation to recommended limits.
Crankcase over-filled	Do not permit lubricant level to exceed FULL mark on dipstick (TM 5-3805-240-12).
Pistons, rings, or connecting rods damaged, worn, or misalined	Overhaul engine to correct defects. Check for worn, broken or improperly installed oil control rings (para 3-97). Check for loose piston retainers and for scored cylinder liners, piston, or oil rings (para 3-96). Inspect for excessive piston and connecting rod misalinement indicating worn crankshaft thrust washers (para 3-164).

2-11. Excessive Engine Crankcase Pressure

Probable cause	Possible remedy
Cylinder blow-by	Check compression pressures (para 3-197). If only one cylinder has low compression replace cylinder head gasket (para 3-77). Inspect the pistons, piston rings (para 3-96), and cylinder liners (para 3-110) for excessive wear, scoring, or damage and replace damaged parts.
Breathers restricted	Clean or replace the breather pads (para 3-187).
Air entering crankcase from blower	Replace blower-to-engine block gasket (para 3-63). Replace cylinder block end plate gasket (para 3-187).
Excessive exhaust back pressure	Check for excessive pressure (para 3-200) and replace or clean damaged or restricted exhaust pipes, tail pipes, or mufflers (TM 5-4805-240-12).

2-12. Low Engine Lubrication Oil Pressure Gage Reading

Probable cause	Possible remedy
Engine too cool	Check the engine water temperature gage and recheck against a known reliable temperature gage. If engine temperature is cool, see paragraph 2-7.
Insufficient oil in crankcase, oil of wrong viscosity	Check oil. Drain crankcase and refill with proper oil or raise level to FULL mark on dipstick (TM 5-3805-240-12).
Defective engine oil pressure gage	Check the engine oil pressure gage against a gage of known reliability. Check the gage line for kinds or restrictions and replace or clean. Inspect gage for damage and replace damaged parts (TM 5-3805-240-12).
Poor engine oil circulation	Replace the engine oil filter element (TM 5-3805-240-12). Remove the oil pan and clean or replace the oil strainer screen (para 3-65). Check the oil cooler for restrictions or damage and clean or replace (para 3-192). Inspect the oil pressure regulator valve and relief valve and clean or replace if necessary. Overhaul the oil pump and install new piping gaskets (para 3-70). Overhaul the engine and check the crankshaft bearings for wear (para 3-70. Check for missing gallery, crankshaft, or camshaft oil plugs.

2-13. Above Normal Engine Water Temperature Gage Reading

Probable cause	Possible remedy
Low coolant level or wrong coolant	Check coolant level at radiator filler and fill if low. Make sure coolant is proper type for climate conditions. Check all cooling system drains and make sure they are tightly closed (TM 5-3805-240-12).
Scale deposits in radiator	Drain cooling system, fill with cleaning compound, and flush system (TM 5-3805-240-12).
Radiator core plugged or damaged	Clean exterior of radiator. Replace leaky radiator core (para 3-2).
Fan slipping or damaged	Replace damaged fan (para 2-40) or fan belt. Adjust fan belt to proper tension (TM 5-3805-240-12).
Hoses damaged or loosely connected	Inspect for collapsed or damaged cooling system hoses or leaky connections. Replace damaged hoses and tighten connections (TM 5-3805-240-12).
Water temperature gage defective	Check for kinks and obstructions in gage tube. Test gage and sending unit against equipment of known reliability. Replace defective parts (TM 5-3805-240-12).
Thermostats defective	Remove and test the thermostat. Replace defective

Probable cause	Possible remedy
	thermostat (TM 5-3805-240-12).
Water pump defective	Check for loose or damaged water pump impeller. Overhaul water pump if defective (para 3-46).
Combustion gases entering cooling system	Remove radiator filler cap and look for evidence of combustion gases. If gases are found, remove cylinder heads and check for cracks (para 3-72). Replace damaged cylinder heads. Use new head gaskets.
Air leak	Check for air leak on suction side of water pump. Replace leaking parts (TM 5-3805-240-12).

2-14. Below Normal Engine Water Temperature Gage Reading

Probable cause	Possible remedy
Water temperature gage defective	See the troubleshooting instructions in paragraph 2-13.
Thermostats defective	Remove and test the thermostat and replace defective units. Check the thermostat seals and replace if faulty (TM 5-3805-240-12).

2-15. Engine Runs, Ditcher Fails to Move

Probable cause	Possible remedy
Transmission control linkage sticking or damaged	Inspect transmission control linkage for sticking or other damage. Check for loose or missing parts. Adjust or repair the linkage andreplace missing parts (para 13-15).
Brakes locked	Release manual brake lock controls. Check for low air pressure at the brake chambers. If the brake camshaft fails to rotate, check the brakes for binding or poor adjustment (TM 5-3805-240-12).
Transfer case defective	Disconnect all universal shaft at the transfer case and check the transfer case input shaft for rotation. If the transfer input shaft fails to rotate, overhaul the transfer case (para 5-5 through 5-22).
Transmission/torque converter defective	Overhaul defective transmission torque converter (para 4-30) through 4-48).
Axles or drive shafts defective	Axles or drive shafts defective damaged universal joints or slip joints, broken shafts, or missing parts. Repair the shafts as necessary (para 10-4 through 10-27). Inspect the axles for broken, misaligned, excessively worn, or slipping gears and bearings and for loose or missing parts. Repair these units as necessary (para 6-2).

2-16. Ditcher Moves Normally in One Direction, Sluggishly or Intermittently in Other Direction

Probable cause	Possible remedy
Transmission clutches defective	Check for damaged clutches. Overhaul transmission and repair leaking or damaged clutches (para 4-30 through 4-48).

2-17. Ditcher Moves Normally in One Speed Range, Sluggishly or Intermittently in Other Speed Range

Probable cause	Possible remedy
Transmission clutch slippage	Check for damaged clutch. Overhaul transmission and repair leaking or damaged clutch (para 4-30 through 4-48).

2-18. Transmission Shifts Roughly

Probable cause	Possible remedy
Control valve defective	Check the control valve for proper operation. Replace parts as necessary (para 4-44).

2-19. Transmission Shifts Slowly

Probable cause	Possible remedy
Control valve defective	Check the control valve for proper operation. Replace parts as necessary (para 4-44).
Transmission oil pressure low	Check the transmission oil pressure gage. If pressure is low, change the torque converter oil filter element and clean or replace the transmission suction filter (TM 5-3805-240-12). Inspect the torque converter and transmission oil lines for loose connections and damage. Tighten loose connections and replace damaged hoses (TM 5-3805-240-12). Test the torque converter charging pump and pressure regulating valves for defective operation (para 4-27). Repair or replace defective units (para 4-30, 4-37, 4-45).

2-20. Noisy Transmission

Probable cause	Possible remedy
Worn piston seals	Overhaul transmission (para 4-30 through 4-48).
Transmission oil level low	Inspect the oil level in the transmission housing and, if low, fill to the FULL plug (TM 5-3805-240-12).
Transmission gears, clutches, or bearings excessively worn or damaged	Replace transmission or replace damaged parts (para 4-30 through 4-48).

2-21. Low Converter Oil Pressure Gage Reading

Probable cause	Possible remedy
Transmission oil level low, or wrong viscosity used	Check the transmission oil level and add oil to FULL plug if low. Make sure proper oil is used for climate conditions (TM 5-3805-240-12).
Torque converter oil line leaky or restricted	Check for air leaks in suction lines and oil leaks in pressure lines. Check for restrictions in suction lines. Change the torque oil filter element and clean or replace the transmission suction filter (TM 5-3805-240-12).
Converter oil pressure gage defective	Check the gage tubing for kinks and restrictions. Check the gage and sending unit against equipment of known accuracy. Replace defective parts (TM 5-3805-240-12).
Torque converter charging pump worn, clogged, or damaged	Test for high torque converter stall speed. If stall speed is high, overhaul torque converter (para 4-30, 4-37).
Excessive oil flow to transmission	Check the operation of the torque converter pressure regulating valve. Clean or replace defective units (para 4-30, 4-45).

2-22. High Converter Oil Pressure Gage Reading

Probable cause	Possible remedy
Insufficient oil flow to transmission	Check the oil lines to the transmission for restrictions (TM 5-3805-240-12). Check the pressure regulating valve at the torque converter charging pump for faulty operation. Clean, adjust, or replace faulty units (para 4-30, 4-45).
Converter element interference or stators incorrectly installed	Check for low engine speed at torque converter stall. Repair torque converter as necessary (para 4-30).
Converter oil pressure gage defective	Replace converter oil pressure gage (TM 5-3805-240-12).

2-23. High Converter Oil Temperature Gage Reading

Probable cause	Possible remedy
Transmission oil level low or oil of wrong viscosity used	Check the transmission oil level and add oil to the FULL plug. Make sure proper oil is used for the ambient temperature (TM 5-3805-240-12).
Transmission oil level high	Drain the transmission housing until the oil level reaches the FULL plug (TM 5-3805-240-12).
Clutch slipping	Overhaul transmission and replace defective clutch (para 4-30 through 4-48).
Brakes dragging	Inspect brakes and adjust as required (TM 5-3805-240-12).
Heat exchanged core clogged or engine cooling system faulty	Check the engine water temperature gage reading. If high, see paragraph 2-13. Check the converter oil cooler core for clogging or other defects (para 3-192). Clean or replace the converter cooling core as necessary.
Low converter charging pressure	Check the converter oil pressure gage reading. If low see paragraph 2-21.
Excessive load	Avoid stalling torque converter. Tighten lead, shift to lower speed range, or operate intermittently.
Converter oil temperature gage defective	Check the gage against a similar gage of known reliability. Replace defective parts (TM 5-3805-240-12).
Torque converter stator locked	Check for symptomatic low maximum speed, Perform stall test to increase converter oil temperature to 230°F. Release load suddenly at this temperature and check rate of temperature fall, with engine at governed high idle speed. Temperature should start to fall within 15 seconds. Slower temperature drop rate indicates locked stator requiring torque converter overhaul (para 4-30).

Probable cause	Possible remedy
Torque converter stator incorrectly installed	Disassemble the torque converter and check all parts for proper installation (para 4-30).

2-24. Low Converter Oil Temperature Gage Reading

Probable cause	Possible remedy
Engine cool	Check the engine cooling system for abnormal cool operation. See paragraph 2-7.
Converter oil temperature gage defective	Check the converter oil temperature gage against a similar gage of known reliability. Replace defective parts (TM 5-3805-240-12).

2-25. High Engine Speed at Converter Stall

Probable cause	Possible remedy
Transmission oil level low	Check the transmission oil level and add oil to the FULL plug. Make sure proper oil is used for the ambient temperature (TM 5-3805-240-12).
Torque converter charging pressure low	Set the troubleshooting instructions in paragraph 2-21.
High torque converter oil temperature	See the troubleshooting instructions in paragraph 2-23.
Clutch slipping	Replace clutch.

2-26. Low Engine Speed at Converter Stall

Probable cause	Possible remedy
Low engine output torque	Perform engine tune-up (para 3-202).
Torque converter element interference	Check for excessive noise at converter stall. If noise level torque converter level is high, overhaul torque converter (para 4-30).
Torque converter stator incorrctly installed	Disassembly torque converter and check all parts for proper installation (para 4-30).

2-27. Low Power Transmission from Torque Converter

Probable cause	Possible remedy
Low converter charging pressure	Check the converter oil pressure gage. If the gage reading is low, see the troubleshooting instructions in paragraph 2-21.
Low engine speed at torque converter stall	Check the stall speed. If low, see the troubleshooting instructions in paragraph 2-26.

2-28. Brakes Fail to Hold

Probable cause	Possible remedy
Brake control out of adjustment	Adjust brakes (TM 5-3805-240-12).
Brake shoes excessively worn.	Test brakes for ability to stall ditcher at full throttle in low speed range. If brakes fail to stall converter, replace worn brake shoes (para 6-4).
Brakes incorrectly assembled	Disassemble brake units and install components correctly (para 6-5).

2-29. Brakes Locked or Dragging

Probable cause	Possible remedy
Parking brakes on	Release parking brakes.
Brake control valves damaged	Check brake valves for full release and adjust or replace parts as necessary (para 9-23).
Loose air line connections	Inspect the brake air line hoses for damage, leaks, or restrictions. Tighten leaky connections and clean or replace restricted or damaged parts (TM 5-3805-240-12).

2-30. Axles Noisy

Probable cause	Possible remedy
Bearings excessively worn or sticking	Keep lubricant level up (TM 5-3805-240-12). Check for leaky seals. Replace worn or damaged bearings (para 6-4).
Planetary gears excessively worn or broken	Replace worn or damaged units (para 6-4).
Propeller shafts incorrectly installed	Check shafts and re-install shafts correctly (para 10-4 through 10-15).

2-31. Digging Boom Fails to Respond to Controls

Probable cause	Possible remedy
Oil level low in hydraulic reservoir	Fill hydraulic reservoir to FULL mark on dipstick (TM 5-3805-240-12).
Control linkages damaged or out of adjustment	Inspect control linkages for loose, missing, or damaged parts. Repair, tighten, or replace parts as necessary (TM 5-3805-240-12).
Hydraulic line broken, obstructed, or disconnected	Tighten connections or replace damaged lines (TM 5-3805-240-12).
Control valve defective	Inspect valve to make sure valve operates properly. Replace missing or damaged parts (para 8-6).
Hydraulic pump or pump drive excessively worn or damaged	Inspect pump and pump drive for damaged or missing parts. Repair or replace parts as necessary (para 8-5).

Probable cause	Possible remedy
Suction filter or pressure filter severely obstructed	Clean or replace suction filter. Clean pressure filter and replace element (TM 5-3805-240-12).

2-32. Digging Boom Responds Sluggishly to Controls

Probable cause	Possible remedy
Insufficient engine power	See paragraph 2-8.
Engine speed low	Where practical, shift to low speed range and operate engine at high governed speed.
System pressure low	Check system pressure and adjust relief valve setting (para 8-6).
Suction filter or pressure filter obstructed	See paragraph 2-31.
Hydraulic lines leaking or obstructed	Check hydraulic lines for obstructions and for damage or loose connections. Clean or replace obstructed or damaged lines and tighten loose connections (TM 5-3805-240-12).
Hydraulic pump or pump drive excessively worn or damaged	See paragraph 2-31.
Digging control valve defective	Overhaul valve and check for damaged spools and chambers. Replace valve if necessary (para 8-6).

2-33. Boom Fails to Hold With Control in "NEUTRAL"

Probable cause	Possible remedy
Control linkages incorrectly adjusted	Adjust control linkages for correct operation (TM 5-3805-240-12).
Boom hoist valve defective	Check valve for damaged spools and chambers, broken springs, or clogging. Clean valve and replace damaged parts as necessary (para 8-6).
Boom hoist cylinders sticking or damaged	Overhaul cylinders and repair or replace damaged parts (para 8-9).
Hydraulic lines leaking or broken	Repair or replace defective parts (TM 5-3805-240-12).
Boom hoist cylinders leaking or excessively worn	Disassemble cylinders and check for worn packings. Replace worn or damaged parts para 8-9).
Oil level low in hydraulic reservoir or wrong oil used	Check oil level in hydraulic reservoir and make sure correct oil is used (TM 5-3805-240-12).

2-34. Conveyor Fails to Respond to Controls

Probable cause	Possible remedy
Control linkage damaged or incorrectly adjusted	Inspect control linkage for bent rod, missing parts, or loose connections. Repair or replace damaged or missing parts or straighten bent rod and adjust linkage correctly (TM 5-3805-240-12).
Oil level low in hydraulic reservoir	Check level on dipstick. Add oil if necessary (TM 5-3805-12).
Hydraulic lines broken, obstructed or disconnected	Tighten connections and replace damaged lines (TM 5-3805-240-12).
Control valve defective	See paragraph 2-31.
Hydraulic pump or pump drive excessively worn or damaged	See paragraph 2-31.
Hydraulic motors excessively worn or damaged	Repair or replace defective motors (para 8-20).
Suction filter or pressure filter severely obstructed	See paragraph 2-31.

2-35. Conveyor Fails to Hold Position

Probable cause	Possible remedy
Conveyor shift control valve defective	Inspect valve for proper operation. Repair or replace valve as required (para 8-6).
Hydraulic motor excessively worn or damaged	See paragraph 2-34.

2-36. Conveyor Responds Sluggishly to Controls

Probable cause	Possible remedy
Insufficient engine power	See paragraph 2-8.
Engine speed low	See paragraph 2-32.
Suction filter or pressure filter obstructed	See paragraph 2-31.
Hydraulic lines leaking or obstructed	See paragraph 2-32.
Hydraulic pump or pump drive excessively worn or damaged	Repair pump as necessary (para 8-19).
Conveyor shift, direction or speed control valve defective	See paragraph 2-32.

2-37. Bucket Line Stalls During Digging Operation

Probable cause	Possible remedy
Ditcher operated in conditions which exceed capacity	Reduce digging depth or reduce bucket line speed to suit operating conditions.
Bucket teeth worn	Replace bucket teeth (TM 5-3805-240-12).
Drive chains broken or off of sprockets	Replace chains (TM-5-3805-240-12).

Probable cause	Possible remedy
Low clutch pressure	Check power cluster for air pressure and fluid level. Add fluid (TM 5-3805-240-12) or repair power cluster (para 9-60 through 9-66) as necessary. Check transfer case clutch pack for warpage or wear and repair or replace as necessary (para 5-8).
Defective sprocket drive assembly	Check sprocket drive for damaged parts and repair as required (para 6-18 through 6-21).
Defective transfer case drive	Inspect transfer case assembly and repair as required (para 5-4 through 5-23).
Transmission/torque converter clutches slipping	Inspect transmission/torque converter and repair as required (para 4-30 through 4-48).

2-38. Unit Fails to Respond to Controls

Probable cause	Possible remedy
Control linkages disconnected or out of adjustment	Check control linkages for correct connection and adjustment. Connect and adjust linkages if necessary (TM 5-3805-240-12).

Section III. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS

2-39. General

This section contains instructions for the removal and installation of major assemblies which are to be removed from the ditcher for replacement, repair or to provide access to other assemblies. The paragraph covering removal and installation of the power steering gear assembly also contains instructions for the adjustment of the power steering. The components to be removed and installed in this section include: engine, engine/transmission as a unit, transfer case, power steering gear assembly, front and rear differentials, front and rear axle housings, principal components of the hydraulic system, principal components of the air system, spoil conveyor, boom follow-up scraper, bucket line, boom right-angle sprocket drive and boom guide.

2-40. Engine

a. Removal.

(1) Refer to TM 5-3805-240-12 and drain the engine cooling system, engine lubrication system and air system.

(2) Refer to TM 5-3805-240-12 and remove air cleaner, engine access panels, hood assembly, front fenders, floor plates, front panels, mufflers, exhaust pipes, exhaust manifolds, grille and heater assembly.

(3) Refer to TM 5-3805-240-12 and disconnect negative ground cable at batteries.

(4) Refer to figure 2-3 and shut off fuel to engine.

(5) Refer to figure 2-3 and remove engine in the numerical order indicated.

b. Installation. Refer to figure 2-3 and install engine in reverse of numerical order indicated.

2-41. Engine/Transmission

a. Removal.

(1) Refer to paragraph 2-40 and figure 2-3 and perform Steps 1 through 14 and 16 through 29.

(2) Refer to figures 2-4, 2-5, and 2-6 and remove the engine and transmission as a unit in numerical order indicated.

***Caution:* Support the engine and transmission on suitable stands or with hoists of sufficient capacity. Do not permit these assemblies to rest on their oil pans.**

b. Separation. Refer to Steps B and D of figure 2-3 and separate the transmission assembly from the engine assembly.

c. Installation. Refer to paragraph 2-40 and figures 2-4, 2-5 and 2-6 and install the engine and transmission as a unit in reverse of the numerical order indicated.

2-42. Transfer Case

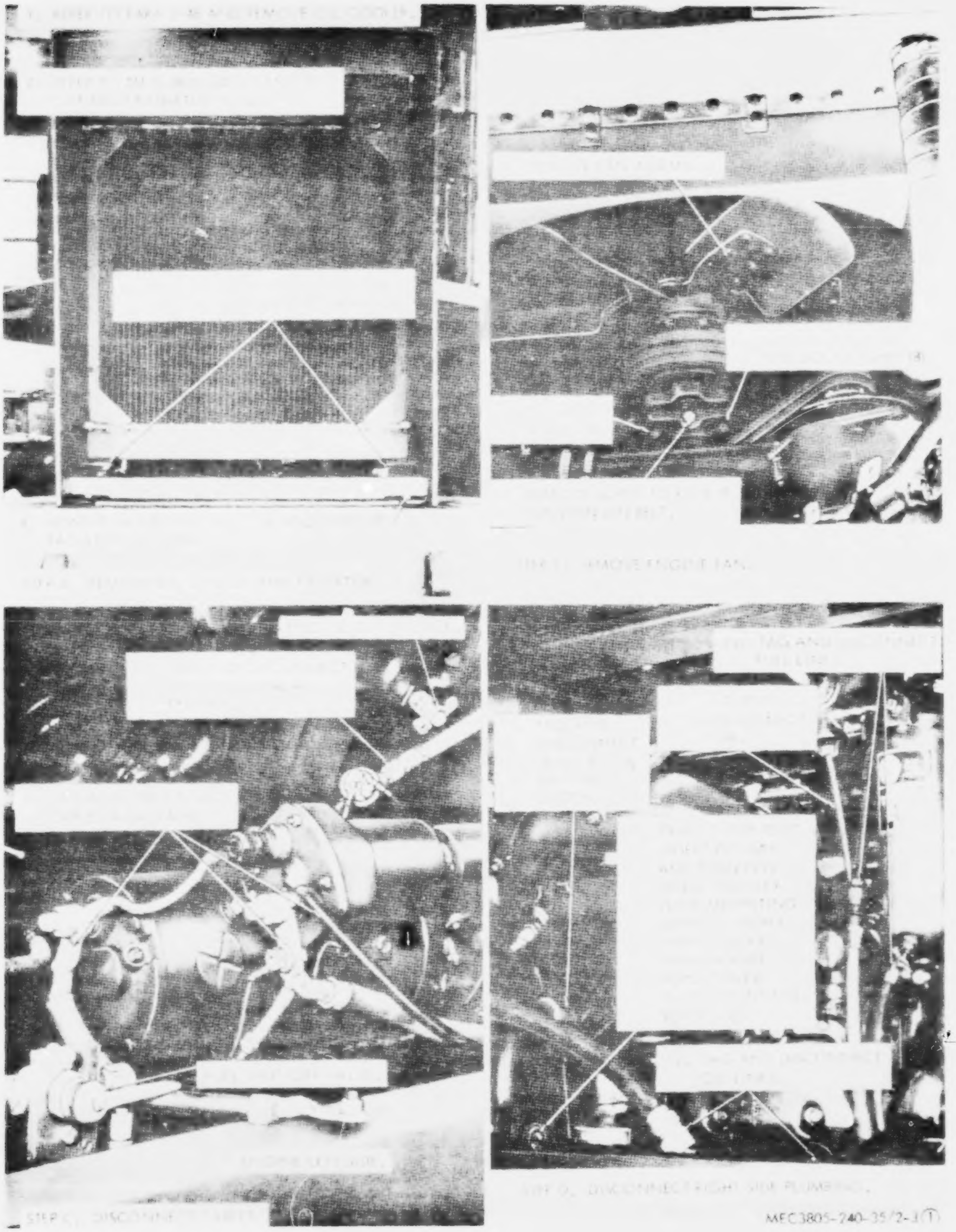
a. Removal. Refer to figure 2-7 and remove transfer case in the numerical order indicated.

b. Installation. Refer to figure 2-7 and install transfer case in reverse of the numerical order indicated.

2-43. Power Steering Unit

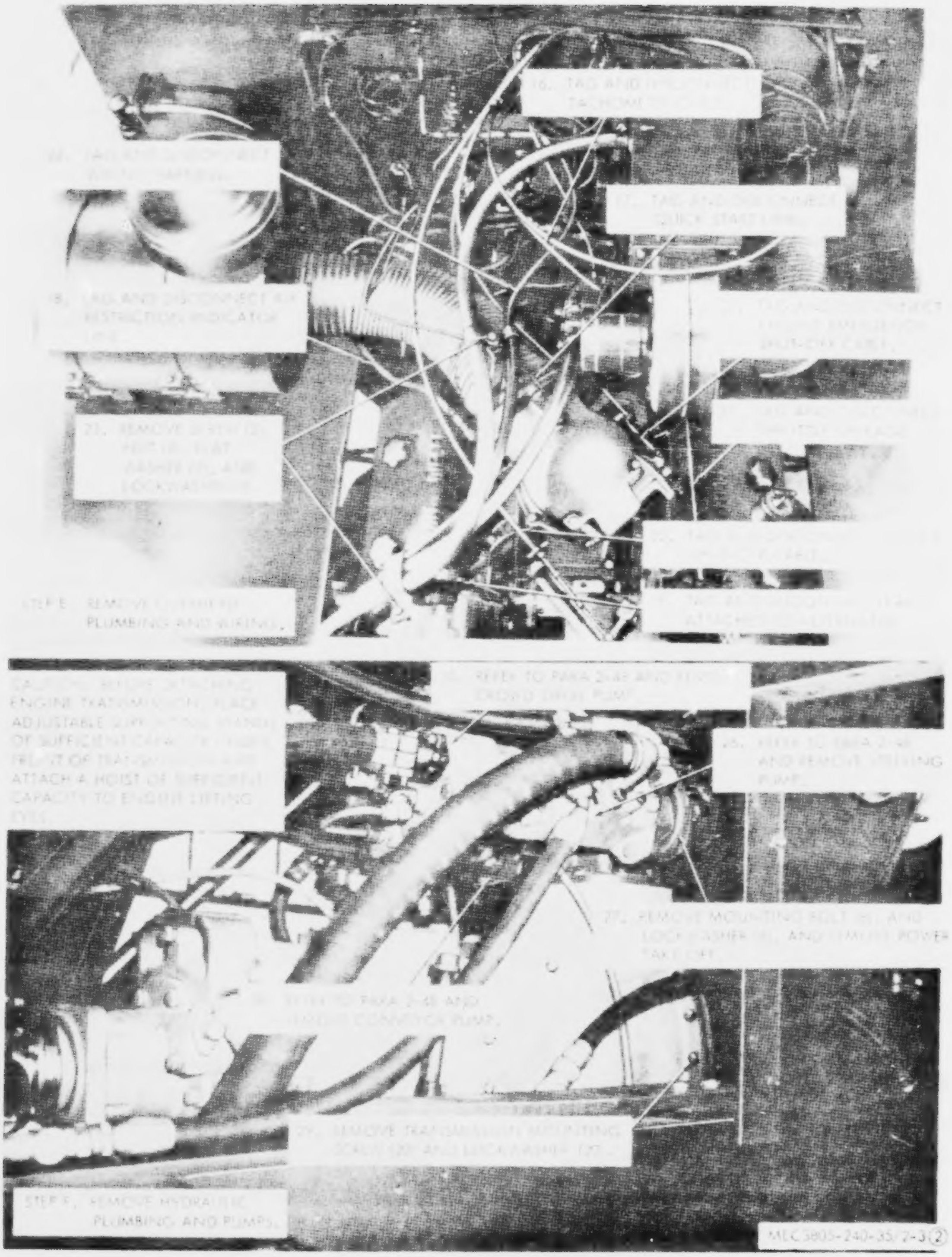
a. Removal. Refer to figure 2-8 and remove the power steering unit in the numerical order indicated.

***Caution:* Do not change the pitman-arm stop-screw adjustment.**


REMOVE ENGINE FAN.
DISCONNECT RIGHT SIDE PLUMBING.

MEC3805-240-35/2-3 ①

Figure 2-3. Engine, removal and installation (sheet 1 of 3).



16. TAG AND DISCONNECT TACHOMETER [illegible].

[illegible] TAG AND DISCONNECT [illegible].

17. TAG AND DISCONNECT QUICK START LINE.

18. TAG AND DISCONNECT AIR RESTRICTION INDICATOR LINE.

[illegible] TAG AND DISCONNECT [illegible] SHUT-OFF CABLE.

[illegible] TAG AND DISCONNECT [illegible].

21. REMOVE SEVEN (7) NUT [illegible], FLAT WASHER [illegible], AND LOCKWASHER [illegible].

[illegible] TAG AND DISCONNECT [illegible] CABLE.

[illegible] TAG AND DISCONNECT [illegible] ATTACHED [illegible].

STEP E. REMOVE OVERHEAD PLUMBING AND WIRING.

CAUTION: BEFORE DETACHING ENGINE TRANSMISSION, PLACE ADJUSTABLE SUPPORTING STAND OF SUFFICIENT CAPACITY UNDER FRONT OF TRANSMISSION AND ATTACH A HOIST OF SUFFICIENT CAPACITY TO ENGINE LIFTING EYES.

25. REFER TO PARA 2-49 AND REMOVE CROWD DRIVE PUMP.

26. REFER TO PARA 2-48 AND REMOVE STEERING PUMP.

27. REMOVE MOUNTING BOLT [illegible], AND LOCKWASHER [illegible], AND REMOVE POWER TAKE-OFF.

28. REFER TO PARA 2-48 AND REMOVE CONVEYOR PUMP.

29. REMOVE TRANSMISSION MOUNTING SCREW [illegible] AND LOCKWASHER [illegible].

STEP F. REMOVE HYDRAULIC PLUMBING AND PUMPS.

MEC 3805-240-35/2-3②

Figure 2-3. Engine, removal and installation (Sheet 2 of 3).

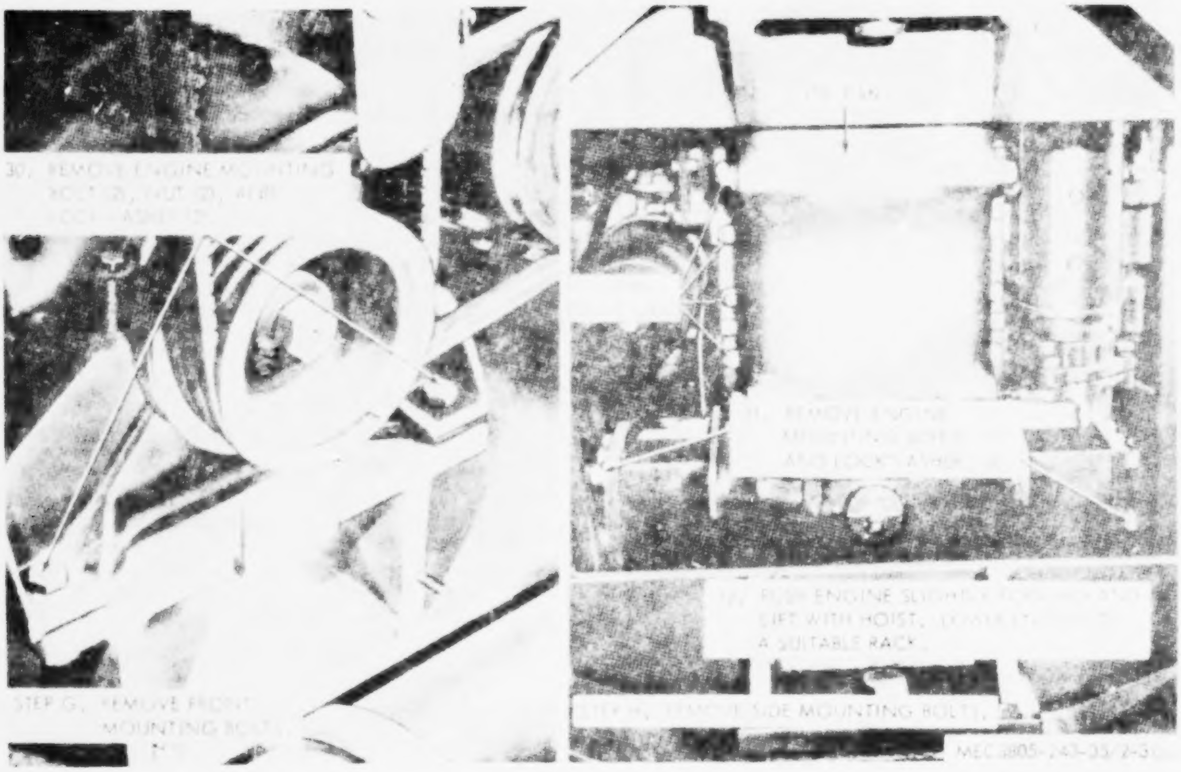

30. REMOVE ENGINE MOUNTING BOLT (2), NUT (2), AND LOCKWASHER (2).
STEP G. REMOVE FRONT MOUNTING BOLTS.
31. REMOVE ENGINE MOUNTING BOLTS AND LOCKWASHERS.
32. PUSH ENGINE SLIGHTLY
LIFT WITH HOIST.
A SUITABLE RACK.
STEP H. REMOVE SIDE MOUNTING BOLTS.
MEC 3805-243-35/2-3

Figure 2–3. Engine, removal and installation (Sheet 3 of 3).

b. Installation. Install the power steering unit in reverse of the numerical order shown in figure 2–8.

Note. Aline the reference marks on the pitman-arm with those on the output shaft. Apply white lead between pitman-arm and lock nut installing.

c. Adjustment.

(1) Loosen jam nuts at each end of housing and turn both plungers into the steering unit housing until they bottom.

(2) Start the ditcher engine and operate at idle speed (550 rpm).

(3) With the full weight of the ditcher on all wheels, turn the steering wheel until one plunger opens the steering unit relief valve. Do not force the steering wheel any further after the relief valve opens; as soon as the valve opens an obvious increase in steering effort will be felt.

Note. Right turns are controlled by the plunger on the top of the unit; left turns by the bottom plunger.

(4) Adjust the plunger outward as a helper continues to turn the wheel. As the plunger is backed off the steering effort lightens. Continue turning the wheel and backing off the plunger until there is 1/16-inch clearance between the pitman-arm and one of the pitman-arm stop-screws. Lock the plunger with the jam nut.

(5) Turn the steering wheel in the opposite direction and repeat Steps (3) and (4) to adjust the other plunger.

Note. If the pitman-arm stop-screws are out of adjustment, use the following procedure to reset them: first, set the power steering relief valve plungers so that they open the valves when there is 1/8-inch clearance between the tie rod arm and the tie rod arm stop-screw (fig. 2–9). Then, adjust the pitman-arm stop-screws so that they clear the pitman-arm by 1/16-inch when the relief valves open.

2–44. Front Differential Assembly

a. Removal. Refer to figure 2–10 and remove the front differential assembly.

Note. Drain entire axle and planetary system before removing differential.

b. Installation. Refer to figure 2–10 and install front differential assembly in reverse of the numerical order.

Note. Before installing cap screws and lockwashers in carrier flange, coat the inside of the flange and the matching surface of the axle housing with plastic gasket. Make certain the plastic compound does not enter screw threads or touch any gears.

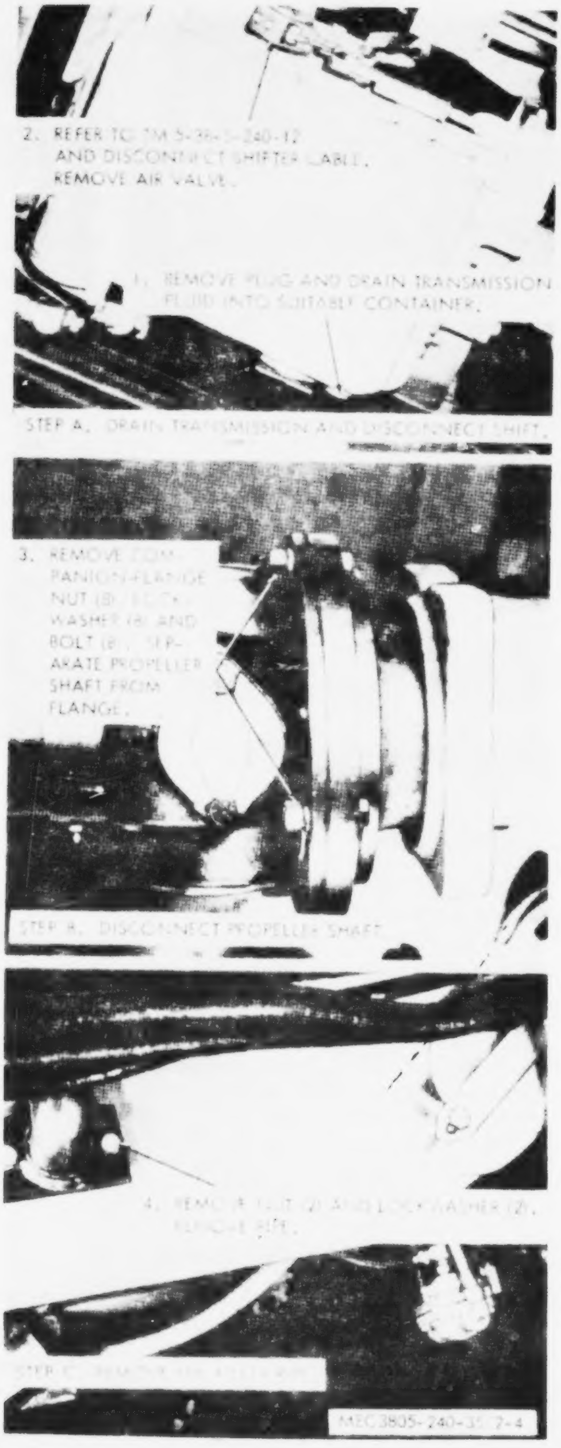

2. REFER TO TM 5-3805-240-12 AND DISCONNECT SHIFTER CABLE. REMOVE AIR VALVE.
1. REMOVE PLUG AND DRAIN TRANSMISSION FLUID INTO SUITABLE CONTAINER.
STEP A. DRAIN TRANSMISSION AND DISCONNECT SHIFT.
3. REMOVE COMPANION-FLANGE NUT (8), LOCKWASHER (8) AND BOLT (8). SEPARATE PROPELLER SHAFT FROM FLANGE.
STEP B. DISCONNECT PROPELLER SHAFT.
4. REMOVE NUT (2) AND LOCKWASHER (2). REMOVE PIPE.
STEP C.
MEC 3805-240-35/2-4

Figure 2-4. Engine/transmission, removal and installation.

2-45. Rear Differential Assembly

a. Removal. Refer to figure 2-11 and remove the rear differential assembly.

Note. Drain entire axle assembly and planetary system before removing differential.

b. Installation. Refer to figure 2-11 and install rear differential assembly in reverse of numerical order.

Note. Before installing cap screws and lockwashers in carrier flange, coat the inside of the flange and the matching surface of the axle housing with plastic gasket. Make certain the plastic compound does not enter screw threads or touch any gears.

2-46. Front Axle Housing

a. Removal. Refer to figure 2-12 and remove front axle housing.

b. Installation. Refer to figure 2-12 and install front axle housing in reverse of the numerical order.

2-47. Rear Axle Housing

a. Removal. Refer to figure 2-13 and remove rear axle housing.

b. Installation. Refer to figure 2-13 and install rear axle housing in reverse of the numerical order.

2-48. Hydraulic System: Principal Components

a. General.

(1) Before removing any part of the hydraulic system, refer to TM 5-3805-240-12 and drain off hydraulic fluid.

(2) Refer to figure 2-14 for the location of hydraulic system components.

(3) Prime individual components after installation by adding hydraulic fluid. Refer to TM 5-3805-240-12 and fill the hydraulic system with fluid after installing components.

***Caution:* Refer to TM 5-3805-240-12 and bleed air from the hydraulic system after installing any component and before operating the ditching machine.**

b. Main Hydraulic Reservoir.

(1) *Removal.* Refer to figure 2-15 and remove main reservoir in the numerical order indicated.

(2) *Installation.* Refer to figure 2-15 and install main reservoir in reverse of the numerical order indicated.

c. In-Line Hydraulic Filter.

(1) *Removal.* Refer to figure 2-16 and remove filter in the numerical order indicated.

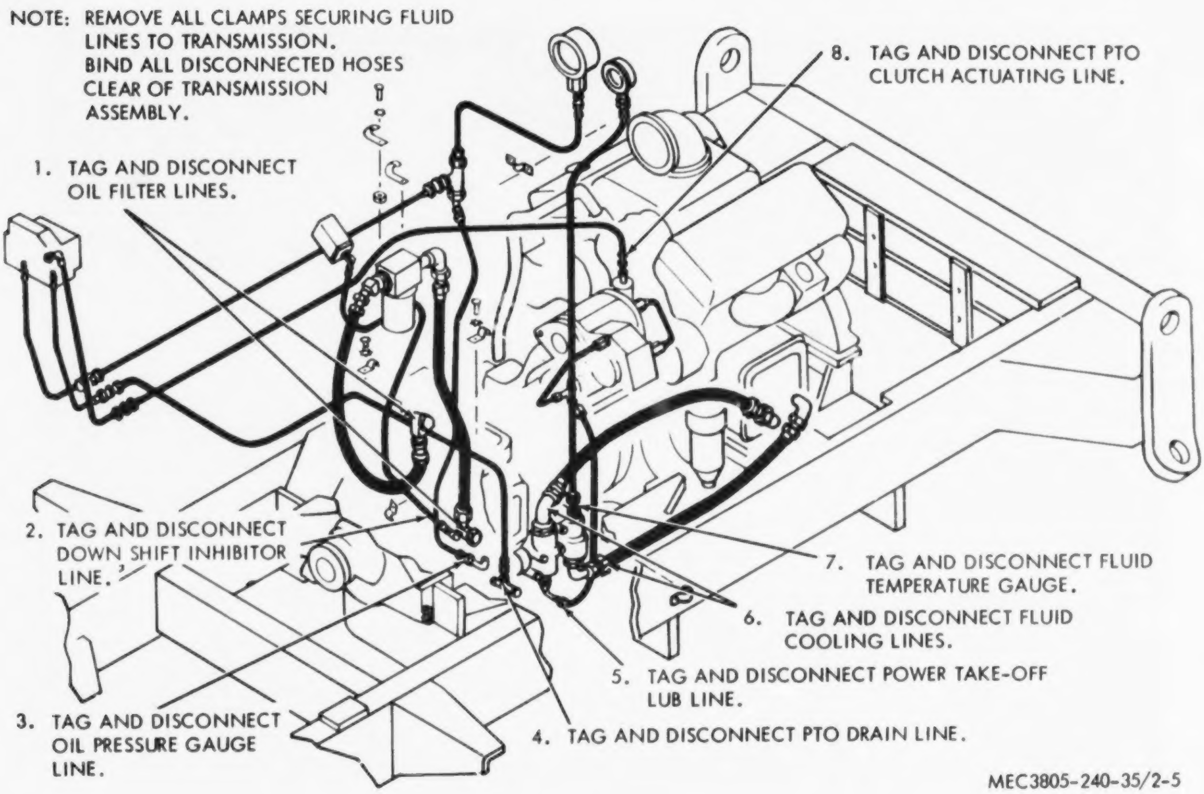

NOTE: REMOVE ALL CLAMPS SECURING FLUID LINES TO TRANSMISSION.
BIND ALL DISCONNECTED HOSES CLEAR OF TRANSMISSION ASSEMBLY.
1. TAG AND DISCONNECT OIL FILTER LINES.
8. TAG AND DISCONNECT PTO CLUTCH ACTUATING LINE.
2. TAG AND DISCONNECT DOWN SHIFT INHIBITOR LINE.
7. TAG AND DISCONNECT FLUID TEMPERATURE GAUGE.
6. TAG AND DISCONNECT FLUID COOLING LINES.
5. TAG AND DISCONNECT POWER TAKE-OFF LUB LINE.
3. TAG AND DISCONNECT OIL PRESSURE GAUGE LINE.
4. TAG AND DISCONNECT PTO DRAIN LINE.
MEC3805-240-35/2-5

Figure 2-5. Transmission fluid line system, disconnection and connection.

(2) *Installation.* Refer to figure 2-16 and install filter in reverse of numerical order indicated.

d. Oil Cooler.

(1) *Removal.* Refer to figure 2-17 and remove oil cooler in the numerical order indiated.

(2) *Installation.* Refer to figure 2-17 and install oil cooler in reverse of the numerical order indicated.

e. Main and Steering Pump Assembly.

(1) *Removal.* Refer to figure 2-18 and remove pump in the numerical order indicated.

(2) *Installation.* Refer to figure 2-18 and install pump in reverse of the numerical order indicated.

f. Crowd-Drive Pump.

(1) *Removal.* Refer to figure 2-19 and remove pump in the numerical order indicated.

(2) *Installation.* Refer to figure 2-19 and install pump in reverse of numerical order indicated.

g. Conveyor Drive Pump Assembly.

(1) *Removal.* Refer to figure 2-20 and remove pump in the numerical order indicated.

(2) *Installation.* Refer to figure 2-24 and install pump in reverse of the numerical order indicated.

h. Crowd-Drive Motor.

(1) *Removal.* Refer to figure 2-21 and remove motor in the numerical order indicated.

(2) *Installation.* Refer to figure 2-21 and install motor in reverse of the numerical order indicated.

i. Relief and Replenishing Valve.

(1) *Removal.* Refer to figure 2-22 and remove valve in the numerical order indicated.

(2) *Installation.* Refer to figure 2-22 and install valve in reverse of numerical order indicated.

j. Conveyor Belt-Drive Directional Control Valve.

(1) *Removal.* Refer to figure 2-23 and remove valve in the numerical order indicated.

(2) *Installation.* Refer to figure 2-23 and install valve in reverse of the numerical order indicated.

k. Four-Way Directional Control Valve Assembly.

(1) *Removal.* Refer to figure 2-24 and remove valve assembly in the numerical order indicated.

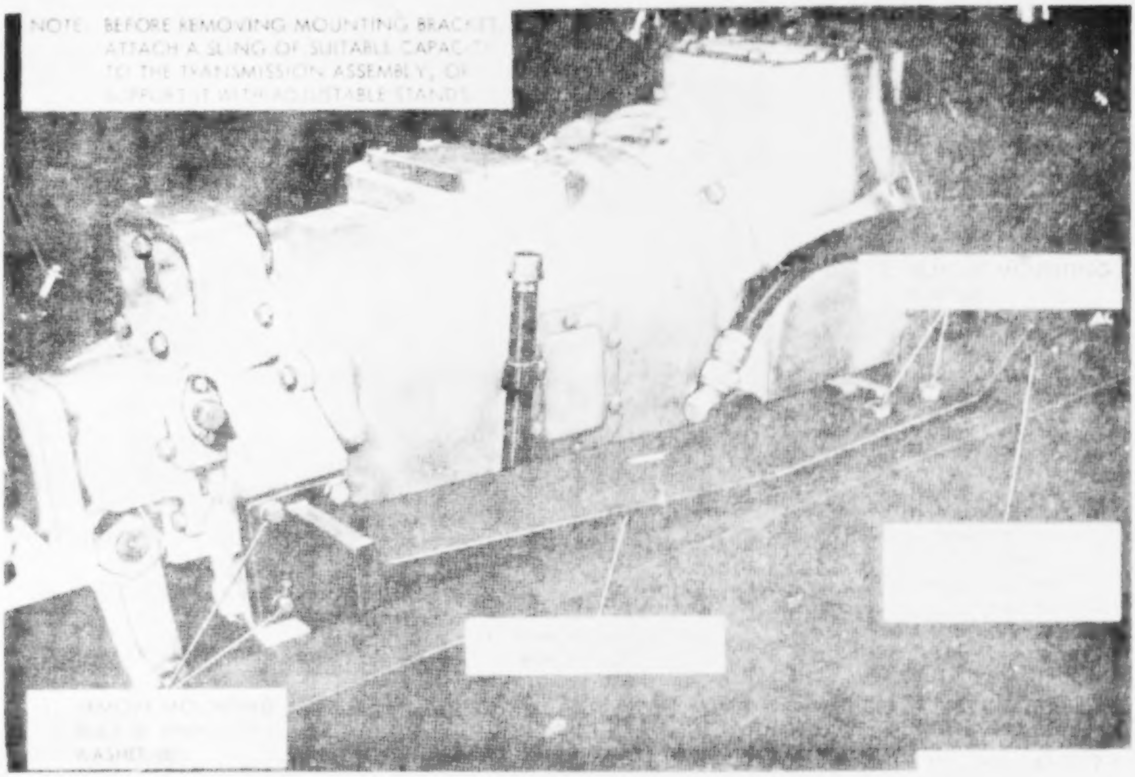

NOTE: BEFORE REMOVING MOUNTING BRACKET, ATTACH A SLING OF SUITABLE CAPACITY TO THE TRANSMISSION ASSEMBLY, OR SUPPORT IT WITH ADJUSTABLE STANDS.
WASHER

Figure 2-6. Transmission mounting bracket, removal and installation.

(2) *Installation.* Refer to figure 2-20 and install valve assembly in reverse of numerical order indicated.

l. Crowd-Pump Control Valve.

(1) *Removal.* Refer to figure 2-25 and remove valve in the numerical order indicated.

(2) *Installation.* Refer to figure 2-25 and install valve in reverse of numerical order indicated.

m. Overcenter Valve Assembly.

(1) *Removal.* Refer to figure 2-26 and remove valve in the numerical order indicated.

(2) *Installation.* Refer to figure 2-26 and install valve in the reverse of numerical order indicated.

n. Check Valve, Left Side.

(1) *Removal.* Refer to figure 2-27 and remove valve in the numerical order indicated.

(2) *Installation.* Refer to figure 2-27 and install valve in reverse of numerical order indicated.

o. Conveyor Belt Drive Motors.

(1) *Removal.* Refer to figure 2-28 and remove motor in the numerical order indicated.

(2) *Installation.* Refer to figure 2-28 and install motor in reverse of the numerical order indicated.

p. Conveyor Shift Drive Motor Assembly.

(1) *Removal.* Refer to figure 2-29 and remove motor in the numerical order indicated.

(2) *Installation.* Refer to figure 2-29 and install motor in reverse of the numerical order indicated.

q. Boom Guide Cylinder Assembly.

(1) *Removal.* Refer to figure 2-30 and remove cylinder assembly in the numerical order indicated.

(2) *Installation.* Refer to figure 2-30 and install cylinder assembly in reverse of numerical order indicated.

r. Boom Hoist Cylinders.

(1) *Removal.* Refer to figure 2-31 and remove cylinders in numerical order indicated.

(2) *Installation.* Refer to figure 2-31 and install cylinders in reverse of numerical order indicated.

s. Follow-Up Scraper Cylinder.

(1) *Removal.* Refer to figure 2-32 and remove scraper cylinder in numerical order indicated.

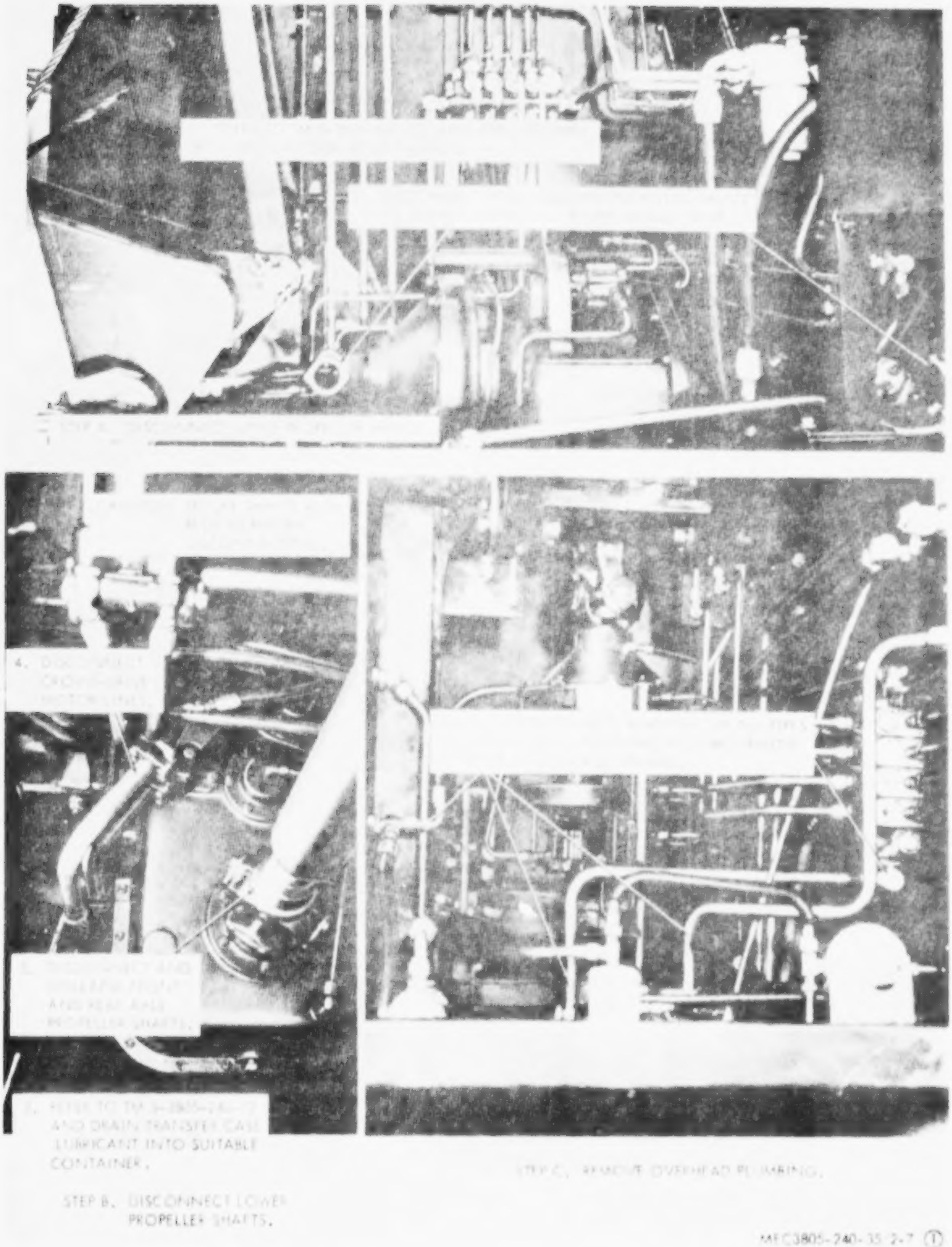
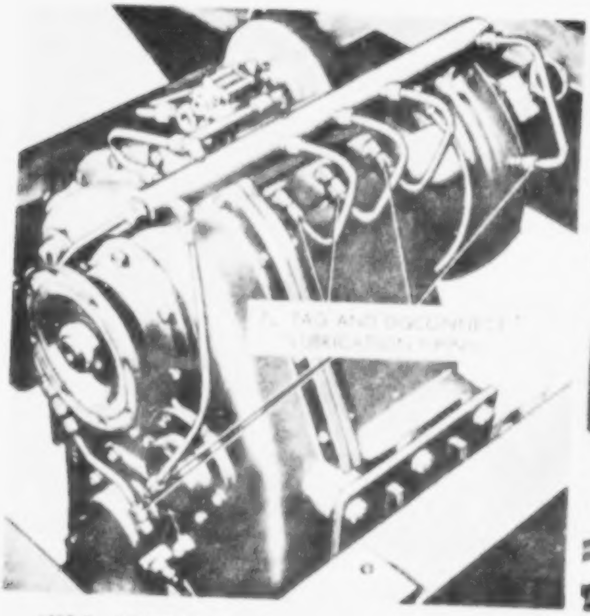
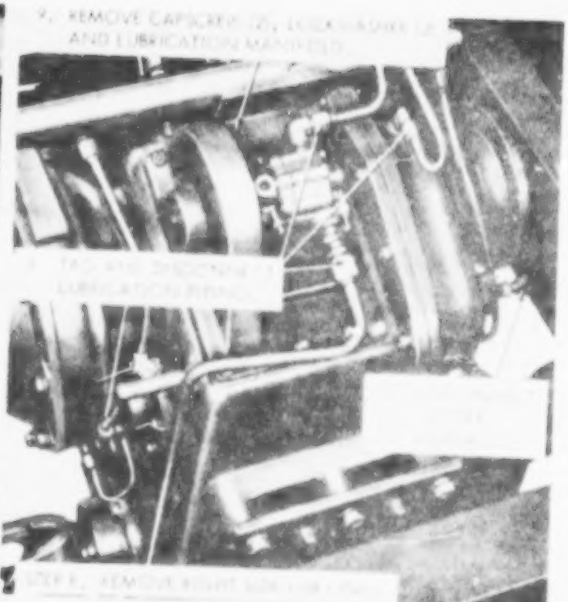

4. DISCONNECT CROWD-DRIVE MOTOR LINES.
5. DISCONNECT AND REMOVE FRONT AND REAR AXLE PROPELLER SHAFTS.
6. REFER TO TM 5-3805-240-12 AND DRAIN TRANSFER CASE LUBRICANT INTO SUITABLE CONTAINER.
STEP B. DISCONNECT LOWER PROPELLER SHAFTS.
STEP C. REMOVE OVERHEAD PLUMBING.
MEC3805-240-35/2-7 ①

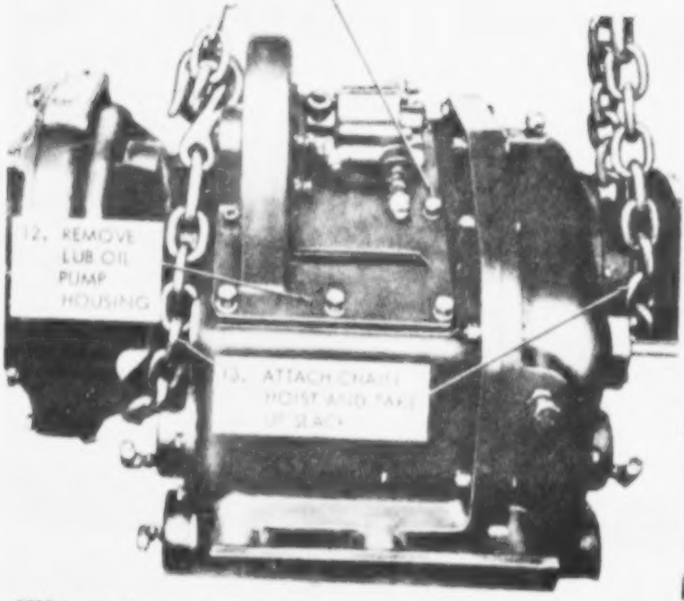
Figure 2-7. Transfer case, removal and installation (Sheet 1 of 2).


7. TAG AND DISCONNECT [illegible] LUBRICATION PIPING.

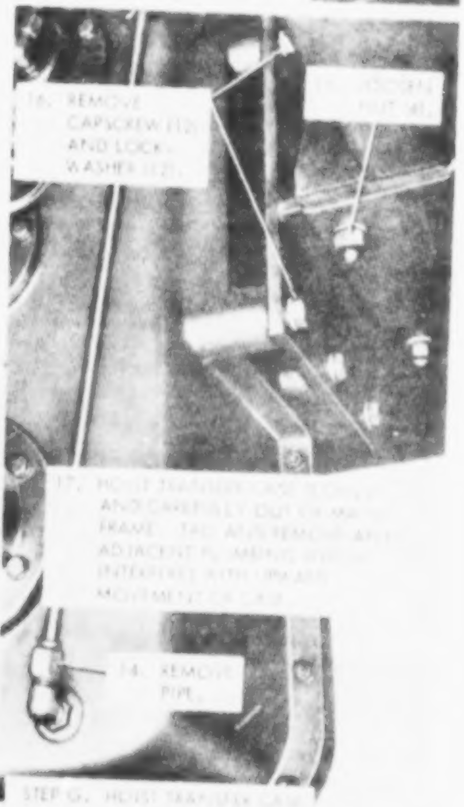
STEP D. REMOVE LEFT SIDE LUB LINES.


9. REMOVE CAPSCREW [illegible], LOCKWASHER [illegible] AND LUBRICATION MANIFOLD.
8. TAG AND DISCONNECT [illegible] LUBRICATION PIPING.
[illegible]

STEP E. REMOVE RIGHT SIDE LUB LINES.


11. REMOVE CAPSCREW (8) AND LOCKWASHER (8).
12. REMOVE LUB OIL PUMP HOUSING
13. ATTACH CHAIN HOIST AND TAKE UP SLACK

STEP F. REMOVE LUB OIL PUMP HOUSING AND ATTACH CHAIN.


16. REMOVE CAPSCREW (12) AND LOCK-WASHER (12).
15. LOOSEN NUT [illegible].
17. HOIST TRANSFER CASE SLOWLY AND CAREFULLY OUT OF MAIN FRAME. TAG AND REMOVE ANY ADJACENT PLUMBING WHICH INTERFERES WITH UPWARD MOVEMENT OF CASE.
14. REMOVE PIPE.

STEP G. HOIST TRANSFER CASE OUT OF FRAME.

MEC3805-240-[illegible] (2)

Figure 2-7. Transfer case, removal and installation (Sheet 2 of 2).

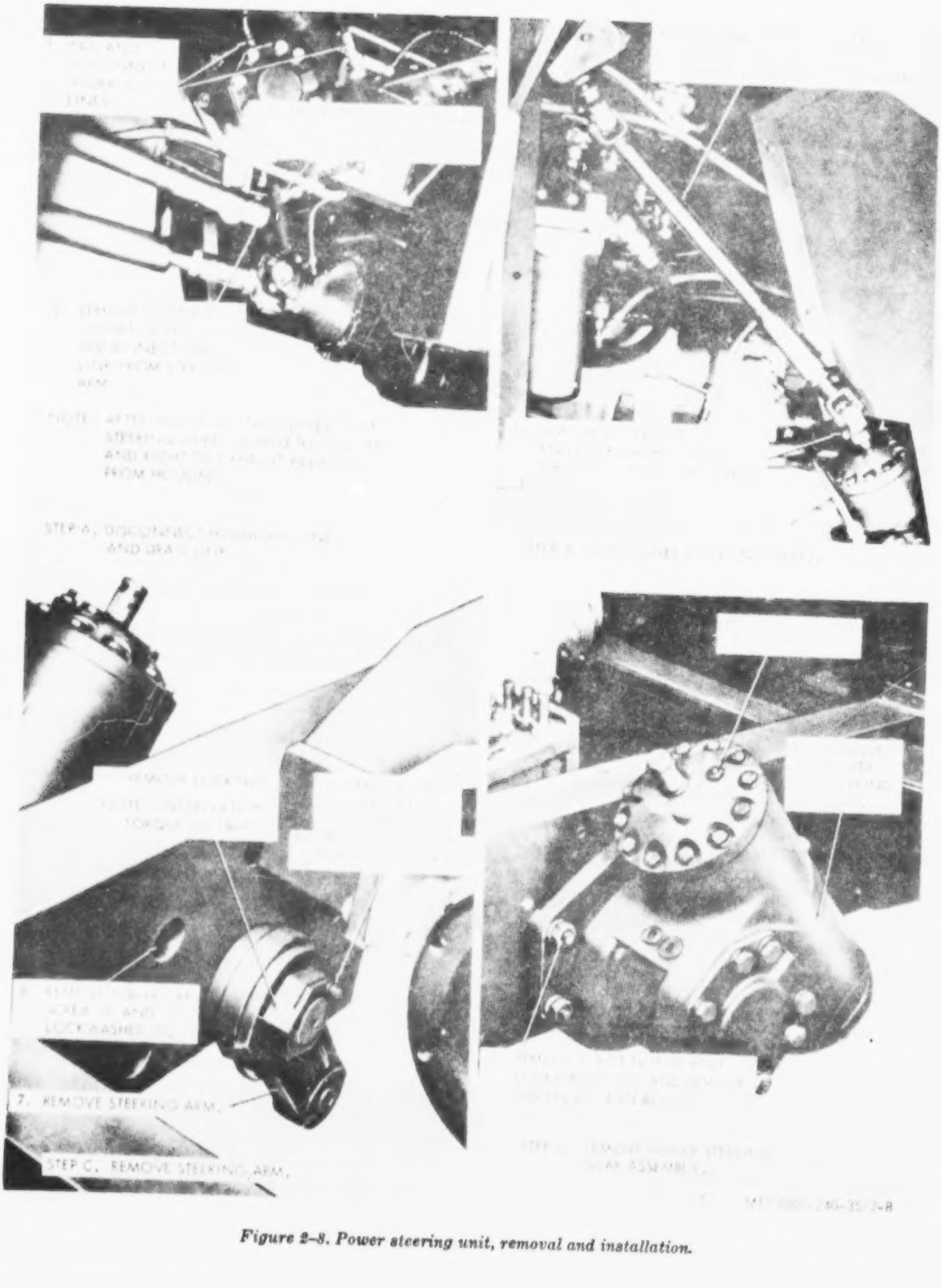
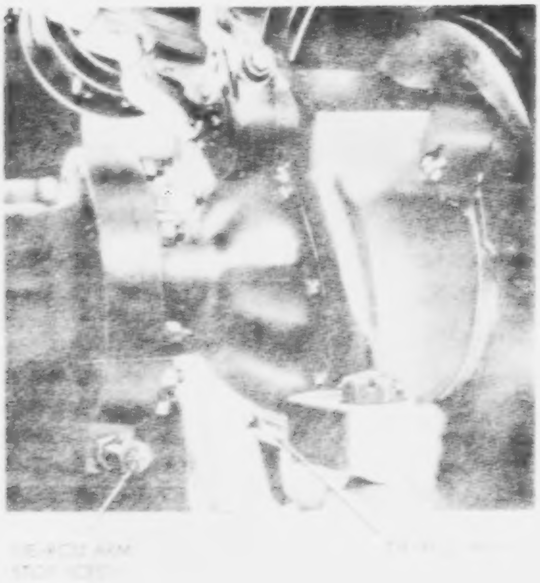

LINES
NOTE: AFTER
STEERING WHEEL
AND
FROM HOUSING
STEP A. DISCONNECT
AND DRAG LINK
REMOVE
LOCKWASHER
7. REMOVE STEERING ARM.
STEP C. REMOVE STEERING ARM.
STEP D. REMOVE POWER STEERING
GEAR ASSEMBLY
ME 3805-240-35/2-8

Figure 2-8. Power steering unit, removal and installation.



TURN STEERING WHEEL UNTIL 1/8 INCH CLEARANCE IS LEFT BETWEEN STOP SCREW AND TIE-ROD ARM.

MEC3805-240-35/2-9

Figure 2-9. Tie rod arm and stop screw, adjustment.

(2) *Installation.* Refer to figure 2-32 and install cylinder in reverse of numerical order indicated.

2-49. Air System: Principal Components

a. Component Location. Refer to figure 9-1 to locate and identify air system components.

b. Exhausting Pressure from Air System.

(1) Shut off engine.

(2) Apply parking brake.

(3) Refer to TM 5-3805-240-12 and bleed air reserviors. When no more air can be exhausted by this procedure, operate the service brake pedal until pressure is exhausted.

(4) Refer to TM 5-3805-240-12 and operate emergency-brake release valve until pressure is exhausted.

c. Compressor Assembly.

(1) *Removal.* Refer to figure 2-33 and remove compressor in numerical order indicated.

(2) *Installation.* Refer to figure 2-33 and install compressor in reverse of numerical order indicated.

d. Air System Governor.

(1) *Removal.* Refer to figure 2-34 and remove governor in the numerical order indicated.

(2) *Installation.* Refer to figure 2-34 and install governor in reverse of numerical order indicated.

e. Brake Valve.

(1) *Removal.* Refer to figure 2-35 and remove brake valve in the numerical order indicated.

(2) *Installation.* Refer to figure 2-35 and install brake valve in reverse of numerical order indicated.

f. Brake Chamber (4).

(1) *Removal.* Refer to figure 2-36 and remove brake chamber in numerical order indicated.

(2) *Installation.* Refer to figure 2-36 and install brake chamber in reverse of numerical order indicated.

g. Quick-Release Valve.

(1) *Removal.* Refer to figure 2-37 and remove valve in numerical order indicated.

(2) *Installation.* Refer to figure 2-37 and install valve in reverse of numerical order indicated.

h. Limiting and Quick-Release Valve.

(1) *Removal.* Refer to figure 2-38 and remove valve in numerical order indicated.

(2) *Installation.* Refer to figure 2-38 and install valve in reverse of numerical order indicated.

i. Relay Valve.

(1) *Removal.* Refer to figure 2-39 and remove valve in the numerical order indicated.

(2) *Installation.* Refer to figure 2-39 and install valve in reverse of numerical order indicated.

j. Power Cluster Assembly.

(1) *Removal.* Refer to figure 2-40 and remove power cluster assembly in the numerical order indicated.

(2) *Installation.* Refer to figure 2-40 and install power cluster assembly in reverse of numerical order indicated.

k. Pilot Air Valve.

(1) *Removal.* Refer to figure 2-41 and remove valve in numerical order indicated

(2) *Installation.* Refer to figure 2-41 and install valve in reverse of numerical order indicated.

l. Single-Compartment Air Reservoir.

(1) *Removal.* Refer to figure 2-42 and remove reservoir in numerical order indicated.

(2) *Installation.* Refer to figure 2-42 and install reservoir in reverse of numerical order indicated.

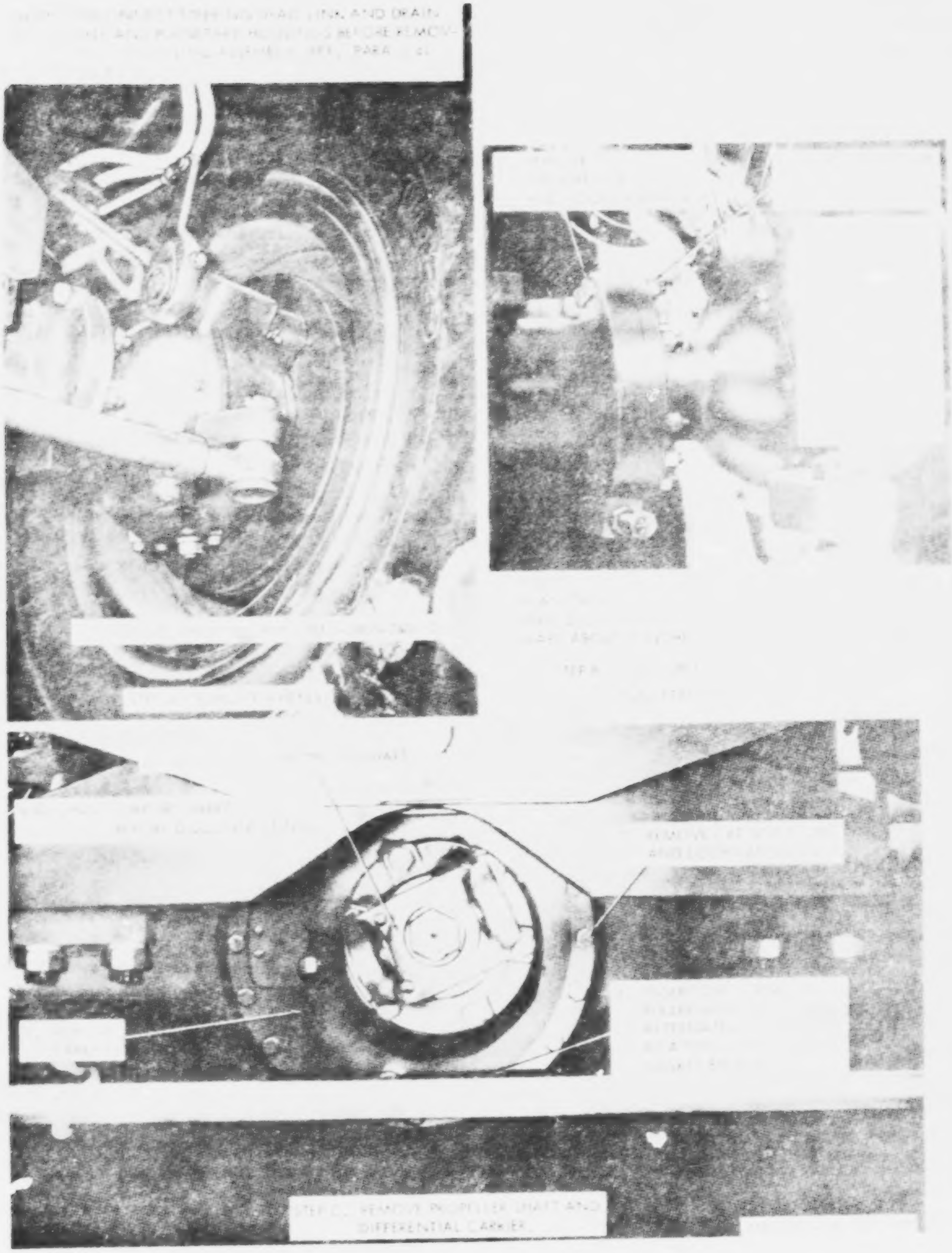

STEP C. REMOVE PROPELLER SHAFT AND DIFFERENTIAL CARRIER.

Figure 2-10. Front differential assembly, removal and installation.

m. Double-Compartment Air Reservoir.

(1) *Removal.* Refer to figure 2-43 and remove reservoir in numerical order indicated.

(2) *Installation.* Refer to figure 2-43 and install reservoir in reverse of numerical order indicated.

2-50. Spoil Conveyor

a. Removal.

(1) Refer to TM 5-3805-240-12 and center the spoil conveyor.

(2) To simplify removal, lower the digging boom into a maintenance pit. If removal is performed out-of-doors, refer to TM 5-3805-240-12 and dig to full boom depth (6 feet), leaving boom in pit to facilitate conveyor removal.

(3) Refer to figure 2-44 and remove spoil conveyor in the numerical order indicated.

b. Installation. Refer to figure 2-44 and install conveyor in reverse of numerical order indicated.

2-51. Follow-Up Scraper

a. Removal. Refer to TM 5-3805-240-12 and remove scraper.

b. Installation. Refer to TM 5-3805-240-12 and install scraper.

2-52. Bucket Line

a. Removal.

(1) Refer to TM 5-3805-240-12 and move the boom guide into digging position. Lower the digging boom until buckets rest on ground.

(2) Refer to figure 2-45 and remove the bucket line in the numerical order indicated.

b. Installation. Refer to figure 2-45 and install bucket line in reverse of numerical order indicated.

2-53. Digging Boom

a. Removal.

(1) Refer to paragraph 2-50 and remove spoil conveyor.

(2) Refer to TM 5-3805-240-12 and remove drive chains and follow-up scraper assembly.

(3) Refer to TM 5-3805-240-12 and move the boom until the boom rollers are alined with the removal holes in the boom-guide track.

(4) Attach a suitable lifting device to the top of the boom and take up slack.

(5) Refer to TM 5-3805-240-12 and remove boom cable.

(6) Tag and disconnect all hydraulic and electrical lines running to boom.

(7) Refer to figure 2-46 and remove boom in numerical order indicated.

b. Installation. Refer to figure 2-46 and install boom in reverse of numerical order indicated.

2-54. Right-Angle Sprocket-Drive Assembly

a. Removal.

(1) Refer to paragraph 2-53 and remove boom assembly from ditcher.

(2) Refer to figure 2-47 and remove sprocket drive from boom guide.

b. Installation. Refer to figure 2-47 and install sprocket drive assembly in reverse of numerical order indicated.

2-55. Hoisting Mast

a. Removal. Refer to TM 5-3805-240-12 and remove mast.

b. Installation. Refer to TM 5-3805-240-12 and install mast.

2-56. Boom Guide

a. Removal.

(1) Refer to paragraph 2-50, 2-51, 2-53, 2-54 and 2-55 and remove spoil conveyor, follow-up scraper, digging boom, sprocket-drive assembly and hoisting mast.

(2) Refer to figure 14-4 and remove the boom-guide shaft (40).

Note. Attach a suitable hoist to boom-guide and take up slack before removing shaft.

b. Installation.

(1) Refer to figure 14-4 and install the boom-guide shaft.

(2) Refer to paragraphs 2-55, 2-54, 2-53, 2-51, and 2-50 and install the hoisting mast, sprocket drive assembly, digging boom, follow-up scraper, and spoil conveyor.

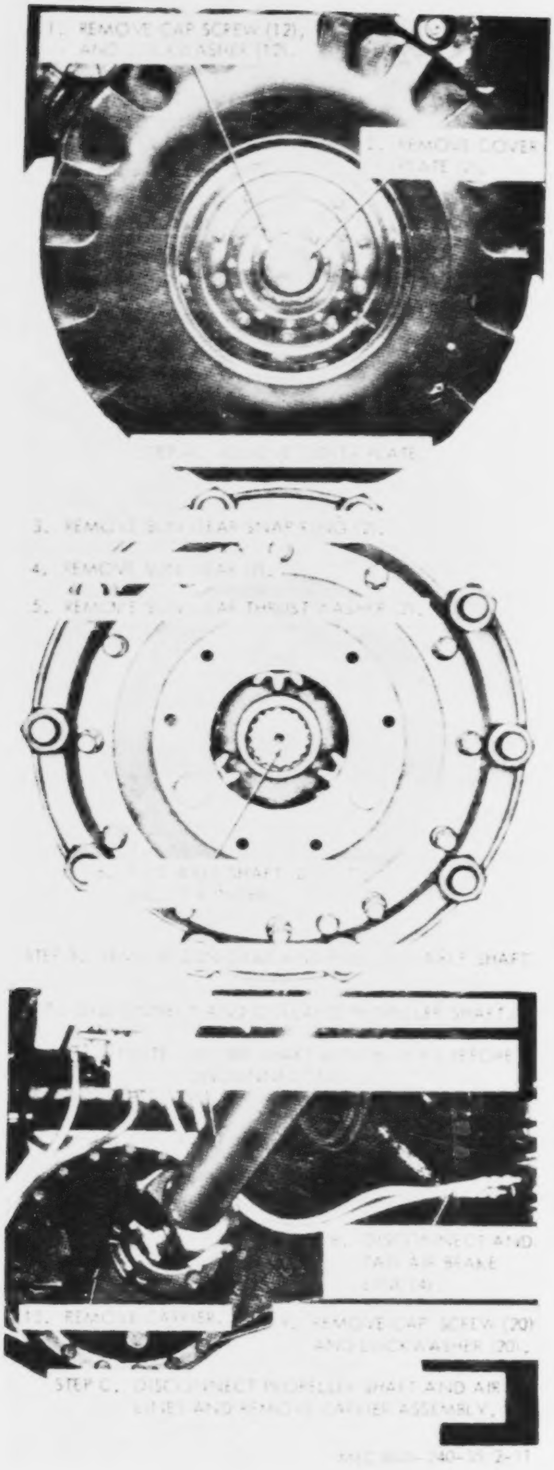

1. REMOVE CAP SCREW (12), AND LOCKWASHER (12).
2. REMOVE COVER PLATE
STEP A. REMOVE COVER PLATE.
3. REMOVE SUN GEAR SNAP RING
4. REMOVE SUN GEAR
5. REMOVE SUN GEAR THRUST WASHER
AXLE SHAFT
STEP B. AXLE SHAFT
PROPELLER SHAFT.
BEFORE
DISCONNECT AND TAG AIR BRAKE LINE (4).
10. REMOVE CARRIER.
REMOVE CAP SCREW (20) AND LOCKWASHER (20).
STEP C. DISCONNECT PROPELLER SHAFT AND AIR LINES AND REMOVE CARRIER ASSEMBLY.
MEC 3805-240-35 2-11

Figure 2-11. Rear differential assembly, removal and installation.

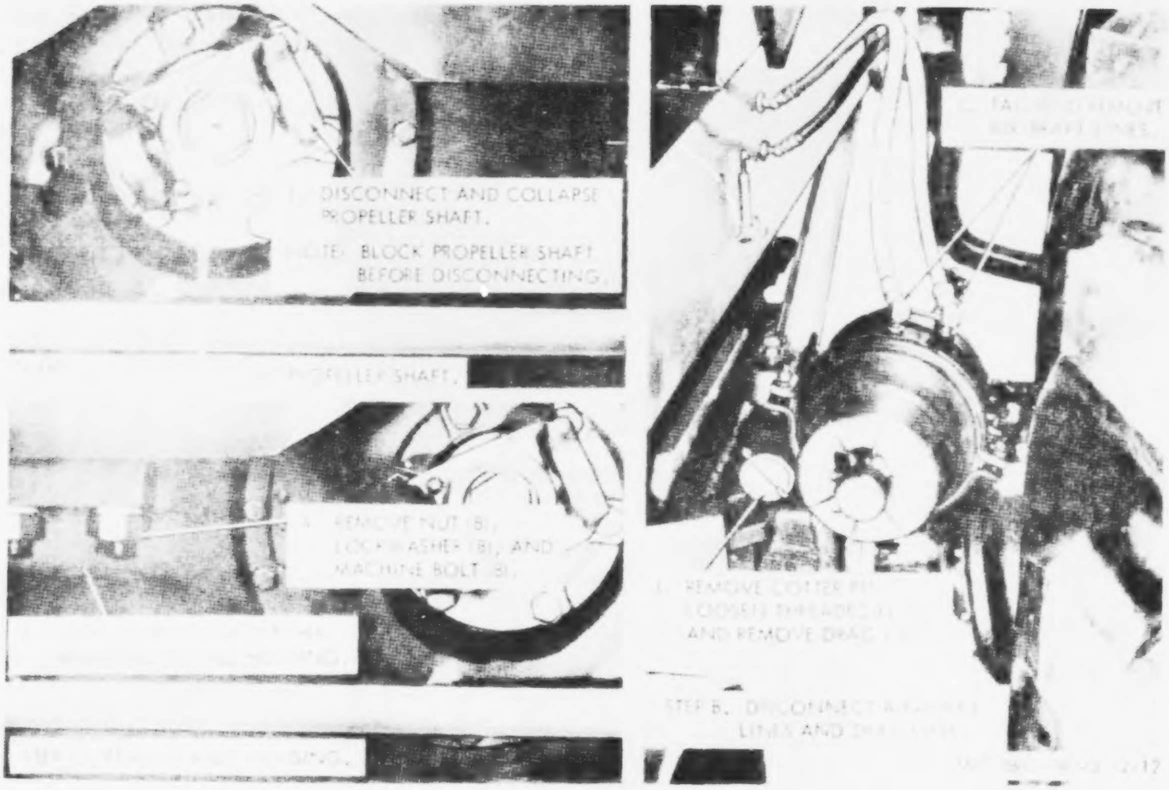

DISCONNECT AND COLLAPSE PROPELLER SHAFT.
BLOCK PROPELLER SHAFT BEFORE DISCONNECTING.
PROPELLER SHAFT.
REMOVE NUT (8), LOCKWASHER (8), AND MACHINE BOLT (8).
REMOVE COTTER PI
LOOSEN THREADED
AND REMOVE DRAG
STEP B. DISCONNECT
LINES AND DRAG

Figure 2-12. Front axle housing, removal and installation.

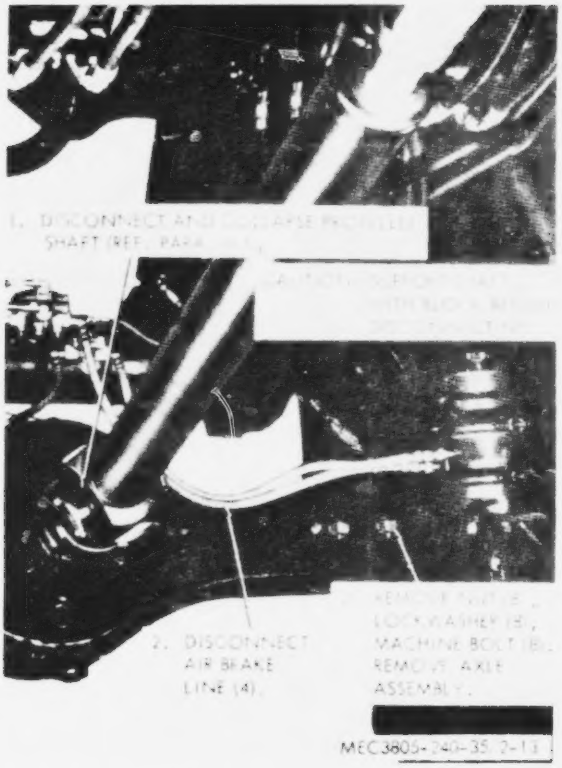
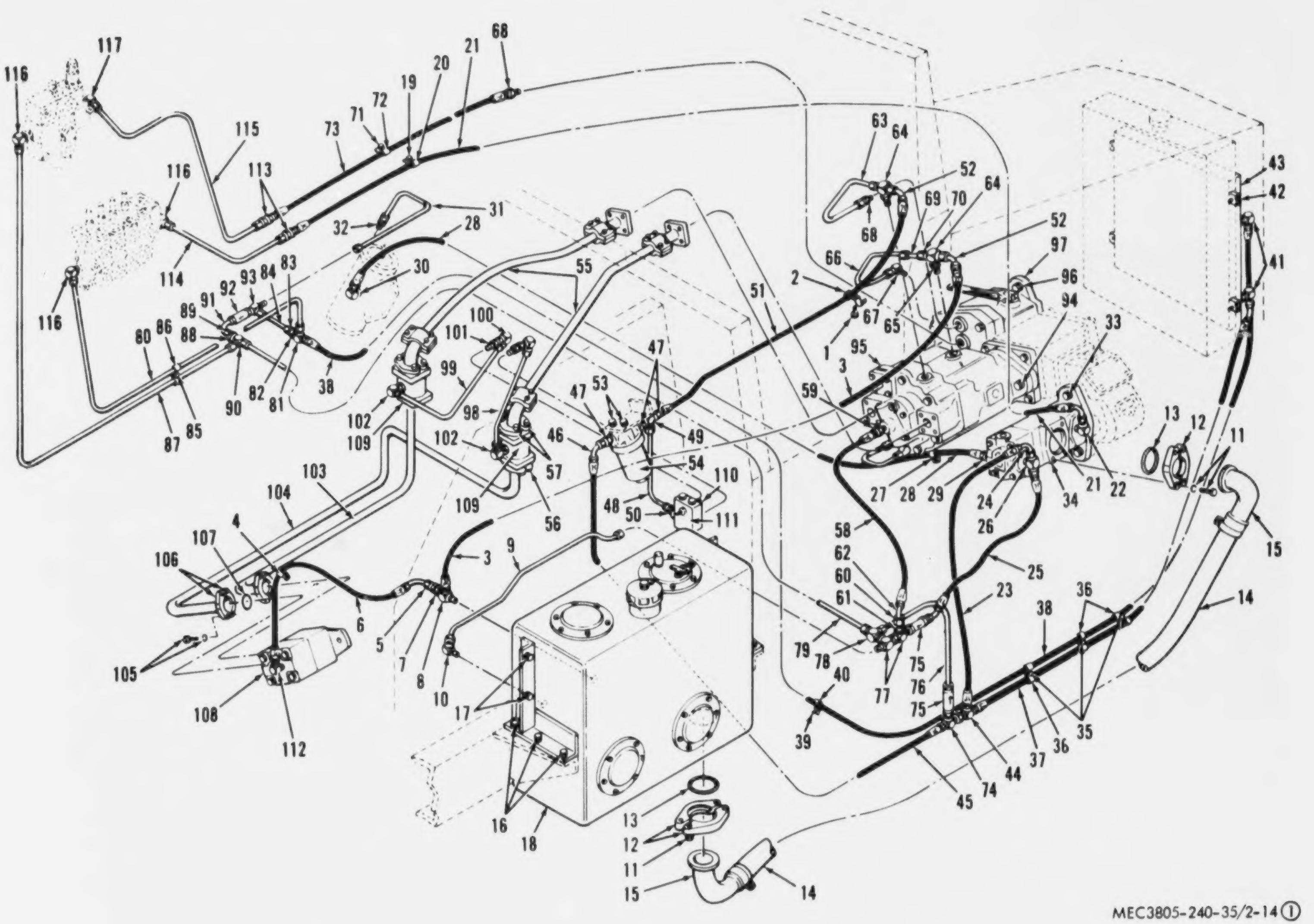

1. DISCONNECT AND COLLAPSE PROPELLER SHAFT (REF. PARA ...).
CAUTION: SUPPORT SHAFT WITH BLOCK BEFORE DISCONNECTING.
2. DISCONNECT AIR BRAKE LINE (4).
3. REMOVE NUT (8), LOCKWASHER (8), MACHINE BOLT (8). REMOVE AXLE ASSEMBLY.
MEC3805-240-35/2-13

Figure 2-13. Rear axle housing, removal and installation.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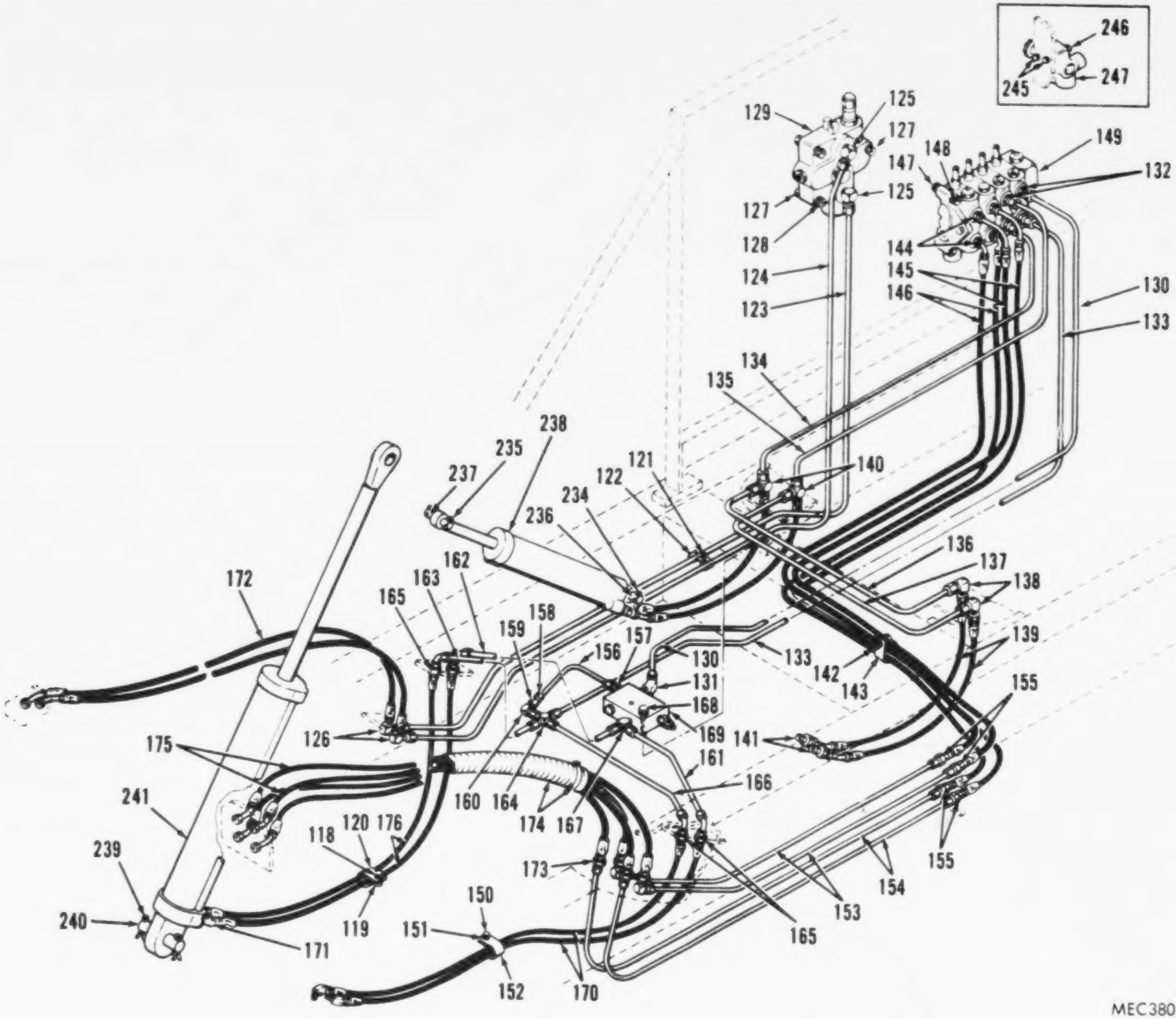
MEC3805-240-35/2-14 ①

Figure 2-14. Hydraulic system components (Sheet 1 of 3).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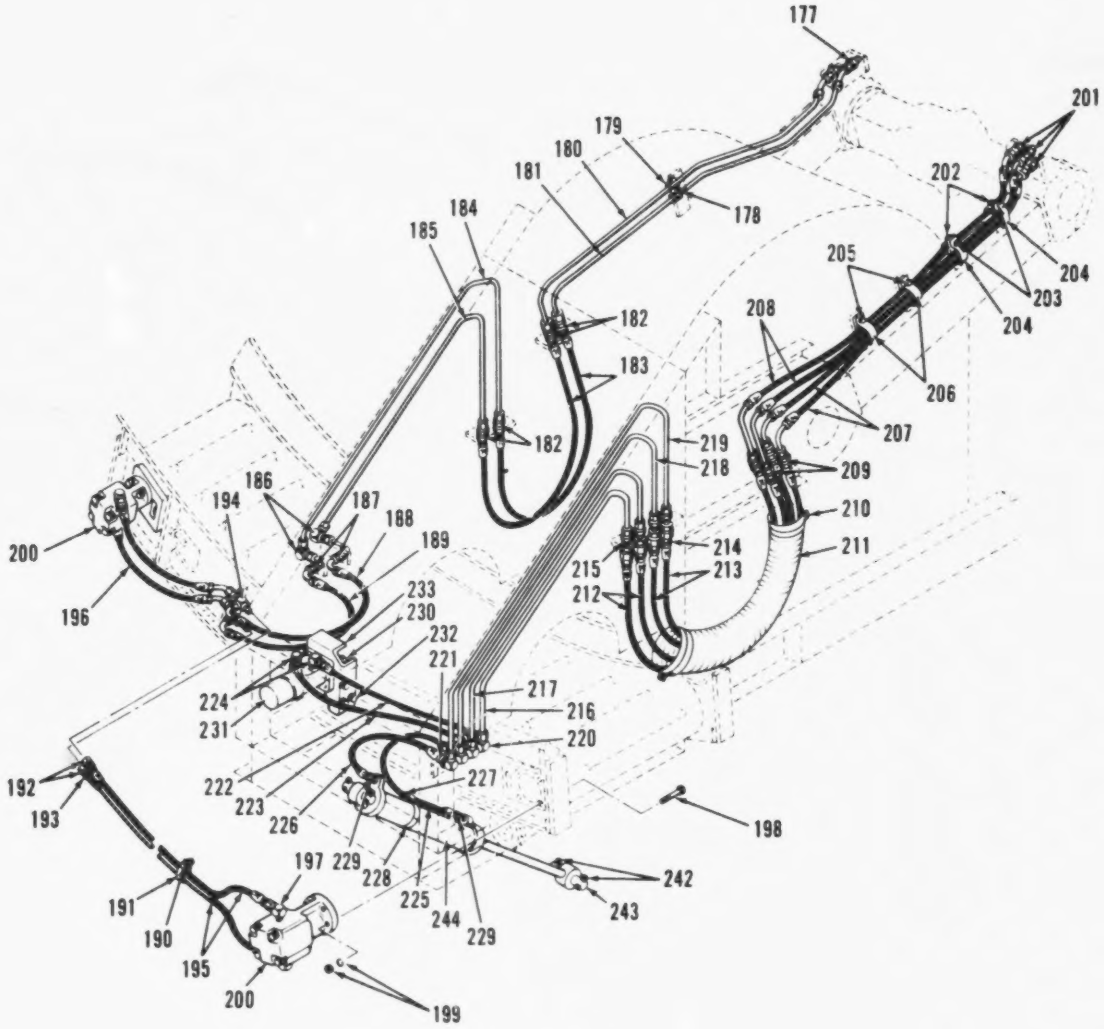
MEC3805-240-35/2-14②

Figure 2-14. Hydraulic system components (Sheet 2 of 3).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MEC3805-240-35/2-14③

Figure 2-14. Hydraulic system components (Sheet 3 of 3).

1	Screw, hex nut, and lockwasher assembly, 3/8–16 x 1 in.
2	Clamp
3	Hose assembly, 3 in. I.D. x 38 in.
4	Clamp
5	Fitting, tube
6	Hose assembly , 1/2 in. I.D. x 30 in.
7	Reducer
8	Tee
9	Tube assembly, 3/4 in. I.D.
10	Elbow, 45 degrees
11	Screw and lockwasher assembly, 3/8–16 x 1 in. (8 rqr)
12	Flange, split
13	Packing, preformed (2 rqr)
14	Hose assembly, with clamps, 2 in. I.D. x 69 in.
15	Elbow (2 rqr)
16	Screw and lockwasher assembly, 3/8–16 x 3/4 in. (4 rqr)
17	Screw and lockwasher assembly, 3/8–16 x 3 /4 in. (4 rqr)
18	Hydraulic tank assembly
19	Screw, nut, and lockwasher assembly, 3/8–16 x 1 in.
20	Clamp, support
21	Hose assembly, 3/4 in. I.D. x 48–1/2 in.
22	Elbow
23	Hose assembly, 3/4 in. I.D. x 48–1/2 in.
24	Elbow
25	Hose assembly, 3/4 in. I.D. x 33 in.
26	Tee
27	Bolt and clamp assembly
28	Hose assembly, 1/2 in. I.D. x 47 in.
29	Elbow, 45 degrees
30	Elbow
31	Tube assembly, 1/2 in. I.D.
32	Adapter
33	Screw and lockwasher assembly, 1/2 – 13 x 1/4 in. (2 rqr)
34	Main and steering pump assembly
35	Nut and lockwasher assembly, 3/8–16 (3 rqr)
36	Clamp (6 rqr)
37	Hose assembly, 3/4 in. I.D. x 100–1/2 in.
38	Hose assembly, 3/4 in. I.D. x 148 in.
39	Screw, nut and lockwasher assembly, 3/8–16 x 1 in.
40	Clamp
41	Elbow (2 rqr)
42	Bolt, lockwasher and flat washer assembly, 5/16–18 x 3/4 in. (4 rqr)
43	Oil cooler assembly
44	Tee
45	Hose assembly, 3/4 in. I.D. x 48–1/2 in.
46	Elbow
47	Adapter
48	Tube assembly, 3/4 in. I.D.
49	Tee
50	Adapter
51	Hose assembly, 3/4 in. I.D. x 42–5/8 in.
52	Elbow, 45 deg (2 rqr)
53	Screw and lockwasher assembly, 1/2–13 x 1 in. (2 rqr)
54	In-line filter assembly
55	Hose assembly, 1–1/4 in. I.D. x 43–1/2 in. (2 rqr)
56	Screw and lockwasher assembly, 7/16–14 x 1–1/2 in. (16 rqr)
57	Flange, split (8 rqr)
58	Hose assembly, 1/2 in. I.D. x 30 in.
59	Adapter
60	Fitting, tube
61	Reducer
62	Elbow, 45 deg
63	Tube assembly, 3/4 in. I.D.
64	Tee
65	Adapter
66	Tube assembly, 3/8 in. I.D.
67	Elbow
68	Adapter (2 rqr)
69	Elbow, 45 deg
70	Fitting, tube
71	Screw, nut, and lockwasher assembly, 3/8–16 x 1 in.
72	Clamp
73	Hose assembly, 3/4 in. I.D. x 49–1/2 in.
74	Tee
75	Valve, check (2 rqr)
76	Tube assembly, 3/4 in. I.D.
77	Tee (2 rqr)
78	Tee
79	Tube assembly, 3/4 in. I.D.
80	Tube assembly, 3/4 in. I.D.
81	Tee
82	Reducer, 3/4 in. to 1/2 in.
83	Fitting, tube
84	Tube assembly, 1/2 in. I.D.
85	Screw and lockwasher assembly, 3/8–16 x 1 in.

Figure 2-14—Continued.

86 Clamp
87 Tube assembly, 3/4 in. I.D.
88 Reducer, 3/4 in. to 1/2 in.
89 Fitting, tube
90 Tee
91 Tube assembly, 1/2 in. I.D.
92 Valve, check
93 Tee
94 Screw and lockwasher assembly, 5/8-11 x 1-1/2 in. (2 rqr)
95 Crowd drive pump assembly
96 Screw and lockwasher assembly, 1/2-13 x 1-1/4 in. (2 rqr)
97 Conveyor drive pump assembly
98 Tube assembly, 3/4 in. I.D.
99 Tube assembly, 3/4 in. I.D.
100 Elbow
101 Adapter
102 Elbow
103 Tube assembly, 1-1/4 in. I.D.
104 Tube assembly, 1-1/4 in. I.D.
105 Screw and lockwasher assembly, 7/16-14 x 1-1/2 in. (4 rqr)
106 Flange, split (4 rqr)
107 Packing, preformed (2 rqr)
108 Crowd drive motor assembly
109 Adapter assembly (2 rqr)
110 Screw, nut and lockwasher assembly, 3/8-16 x 2-1/4 in. (2 rqr)
111 Relief and replenishing valve assembly
112 Elbow
113 Fitting, bulkhead (2 rqr)
114 Tube assembly, 3/4 in. I.D.
115 Tube assembly, 3/4 in. I.D.
116 Elbow (3 rqr)
117 Elbow (3 rqr)
118 Screw, nut and lockwasher assembly, 3/8-15 x 1 in.
119 Washer, flat, 3/8 in.
120 Clamp
121 Screw and lockwasher assembly, 3/8-16 x 1 in.
122 Clamp
123 Tube assembly, 3/4 in. I.D.
124 Tube assembly, 3/4 in. I.D.
125 Elbow (2 rqr)
126 Elbow, union, 90 deg (2 rqr)
127 Screw, 1/2-13 x 4 in. (3 rqr)
128 Nut, jam, 1/2-13 (6 rqr)
129 Conveyor drive directional valve assembly
130 Tube assembly, 1/2 in. I.D.
131 Elbow, 45 deg.
132 Adapter (4 rqr)
133 Tube assembly, 1/2 in. I.D. (B port)
134 Tube assembly, 1/2 in. I.D. (A port)
135 Tube assembly, 1/2 in. I.D. (B port)
136 Tube assembly, 1/2 in. I.D. (A port)
137 Tube assembly, 1/2 in. I.D. (B port)
138 Adapter (2 rqr)
139 Hose assembly, 1/2 in. x 27-3/4 in. (4 rqr)
140 Tee, bulkhead (2 rqr)
141 Adapter (4 rqr)
142 Screw, nut and lockwasher assembly, 3/8-16 x 1 in.
143 Clamp
144 Adapter (4 rqr)
145 Hose assembly, 3/8 in. I.D. x 70 in. (2 rqr) (A port)
146 Hose assembly, 3/8 in. I.D. x 73-1/2 in. (2 rqr)
147 Screw, 5/16-18 x 2-3/4 in. (3 rqr)
148 Nut, jam, 5/16-16 (6 rqr)
149 Four-section control valve assembly
150 Screw, nut and lockwasher assembly, 3/8-16 x 1 in.
151 Washer, flat
152 Clamp
153 Tube assembly, 3/8 in. I.D. (2 rqr)
154 Tube assembly, 3/8 in. I.D. (2 rqr)
155 Union, bulkhead (4 rqr)
156 Tube assembly, 1/8 in. I.D.
157 Adapter
158 Reducer, 1/2 in. to 1/4 in.
159 Fitting, tube, 1/2 in.
160 Elbow
161 Tube assembly, 1/2 in. I.D.
162 Tube assembly, 1/2 in. I.D.
163 Tube assembly, 1/2 in. I.D.
164 Union, cross
165 Union, bulkhead (4 rqr)
166 Tube assembly, 1/2 in. I.D.
167 Tee
168 Screw and lockwasher assembly, 5/16-18 x 1-3/ 4in. (2 rqr)
169 Overcenter valve assembly
170 Hose assembly, 1/2 in. I.D. x 59 in. (4 rqr)
171 Elbow, 45 deg. (4 rqr)

Figure 2-14—Continued

172	Hose assembly, 3/4 in. I.D. x 71 in. (2 rqr)
173	Union, bulkhead (2 rqr)
174	Hose sleeve and clamp assembly
175	Hose assembly, 3/8 in. I.D. x 40-1/2 in.
176	Hose assembly, 3/8 in. I.D. x 37-3/4 in.
177	Union, bulkhead (2 rqr)
178	Screw, nut, and lockwasher assembly, 3/8-16 x 1 in.
179	Clamp
180	Tube assembly, 3/4 in. I.D.
181	Tube assembly, 3/4 in. I.D.
182	Fitting, bulkhead (4 rqr)
183	Hose assembly, 3/4 in. I.D. (2 rqr)
184	Tube assembly, 3/4 in. I.D.
185	Tube assembly, 3/4 in. I.D.
186	Elbow (2 rqr)
187	Adapter (2 rqr)
188	Hose assembly, 3/4 in. I.D. x 43-1/2 in.
189	Hose assembly, 3/4 in. I.D. x 43-1/2 in.
190	Screw, nut and lockwasher assembly, 3/8-16 x 3/4 in. (2 rqr)
191	Clamp (2 rqr)
192	Fitting, hose (4 rqr)
193	Reducer (4 rqr)
194	Tee, bulkhead (2 rqr)
195	Hose assembly (2 rqr)
196	Hose assembly (2 rqr)
197	Elbow (4 rqr)
198	Bolt, 3/8-16 x 2 in. (8 rqr)
199	Nut and lockwasher assembly, 3/8-16 (8 rqr)
200	Conveyor drive motor assembly (2 rqr)
201	Union, bulkhead (4 rqr)
202	Screw, nut and lockwasher assembly, 3/8-16 x 1 in. (2 rqr)
203	Washer, flat (2 rqr)
204	Clamp (2 rqr)
205	Screw, nut and lockwasher assembly, 3/8-16 x 1 in. (2 rqr)
206	Clamp (2 rqr)
207	Hose assembly, 3/8 in. I.D. x 70 in. (2 rqr)
208	Hose assembly, 3/8 in. I.D. x 71-3/4 in. (2 rqr)
209	Union, bulkhead (4 rqr)
210	Clamp (2 rqr)
211	Sleeve
212	Hose assembly, 3/8 in. I.D. x 46-1/4 in. (2 rqr)
213	Hose assembly, 3/8 in. I.D. x 49 in. (2 rqr)
214	Coupler (4 rqr)
215	Adapter (8 rqr)
216	Tube assembly, 3/8 in. I.D.
217	Tube assembly, 3/8 in. I.D.
218	Tube assembly, 3/8 in. I.D.
219	Tube assembly, 3/8 in. I.D.
220	Elbow (4 rqr)
221	Washer, flat, 1/2 in. (4 rqr)
222	Hose assembly, 3/8 in. I.D. x 54 in.
223	Hose assembly, 3/8 in. I.D. x 36 in.
224	Elbow (2 rqr)
225	Hose assembly, 3/8 in. I.D. x 43 in.
226	Hose assembly, 3/8 in. I.D. x 21 in.
227	Clip, hose
228	Clamp, hose
229	Adapter (2 rqr)
230	Screw and lockwasher assembly, 3/8-16 x 1 in. (4 rqr)
231	Conveyor shift motor assembly
232	Screw, nut and lockwasher assembly, 1/2-13 x 2 in. (4 rqr)
233	Bracket, mounting
234	Pin, cotter, 1/4 in. x 3 in. (6 rqr)
235	Pin, cotter, 1/4 in. x 2 in. (4 rqr)
236	Pin, anchor (2 rqr)
237	Pin, anchor (2 rqr)
238	Boom guide cylinder assembly (2 rqr)
239	Pin, cotter, 1/4 in. x 5 in. (4 rqr)
240	Pin, anchor (2 rqr)
241	Boom hoist cylinder assembly (2 rqr)
242	Pin, cotter, 3/16 in. x 1-3/4 in. (4 rqr)
243	Pin, anchor (2 rqr)
244	Follow-up scraper cylinder assembly
245	Screw, 5/16-18 x 1-3/4 in. (2 rqr)
246	Nut, jam, 5/16-18 (2 rqr)
247	Crowd drive pump start-stop valve assembly

Figure 2-14—Continued

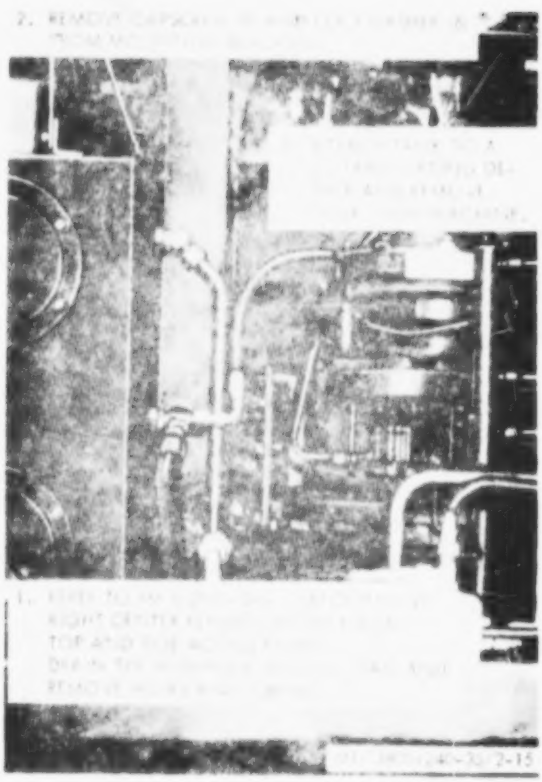
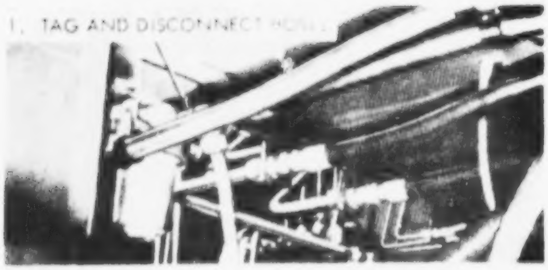
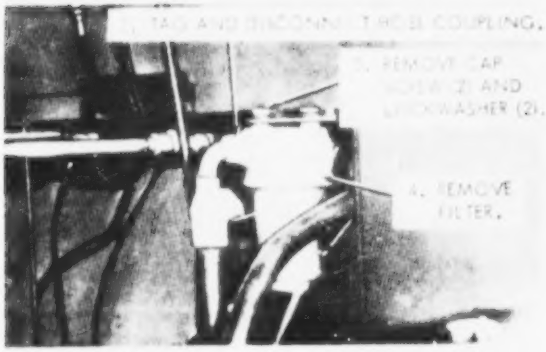

2. REMOVE CAPSCREWS
1. REFER TO
RIGHT CENTER
TOP AND SIDE ACCESS
DRAIN THE HYDRAULIC
REMOVE
2-15

Figure 2-15. Main hydraulic reservoir, removal and installation.


1. TAG AND DISCONNECT HOSE.

STEP A. DISCONNECT FORWARD PLUMBING.


2. TAG AND DISCONNECT HOSE COUPLING.
3. REMOVE CAP SCREW (2) AND LOCKWASHER (2).
4. REMOVE FILTER.

STEP B. DISCONNECT REAR PLUMBING
AND REMOVE FILTER.

MEC3805-240-35/2-16

Figure 2-16. In-line hydraulic filter, removal and installation.

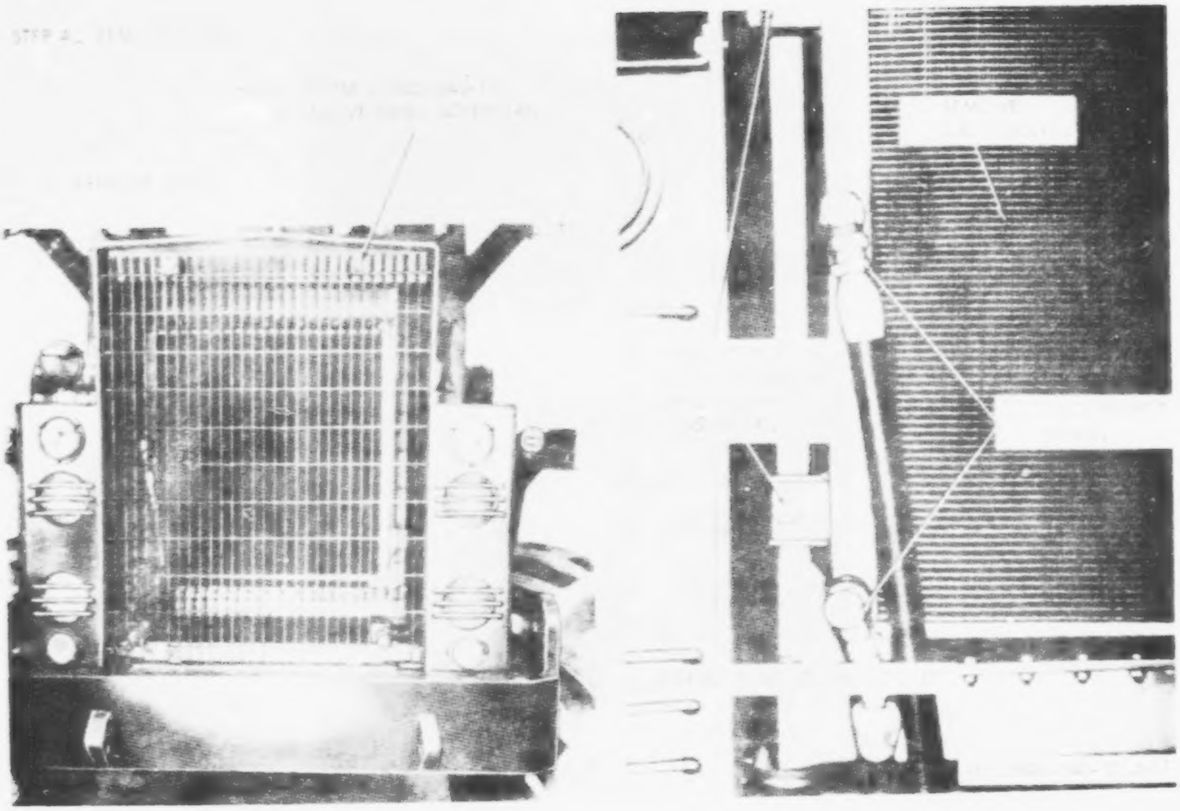

STEP A.
REMOVE

Figure 2-17. Oil cooler, removal and installation.

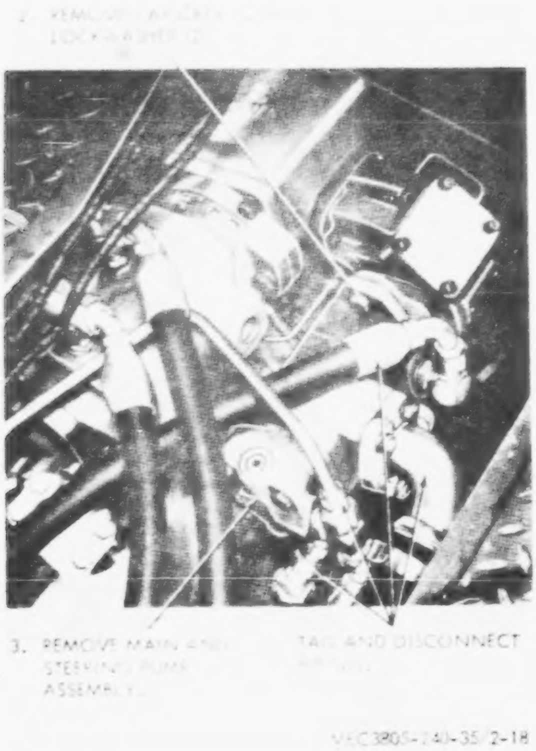
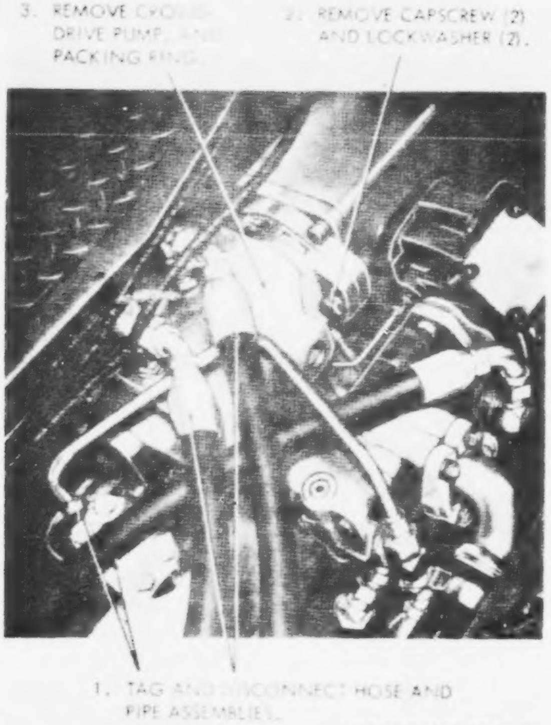

2. REMOVE CAPSCREW (2) AND LOCKWASHER (2)
3. REMOVE MAIN AND STEERING PUMP ASSEMBLY.
TAG AND DISCONNECT FITTINGS.
VEC3805-240-35/2-18

Figure 2-18. Main and steering pump assembly, removal and installation.


3. REMOVE CROWD-DRIVE PUMP, AND PACKING RING.
2. REMOVE CAPSCREW (2) AND LOCKWASHER (2).
1. TAG AND DISCONNECT HOSE AND PIPE ASSEMBLIES.

MEC 3805-240-35/2-19

Figure 2-19. Crowd-drive pump, removal and installation.

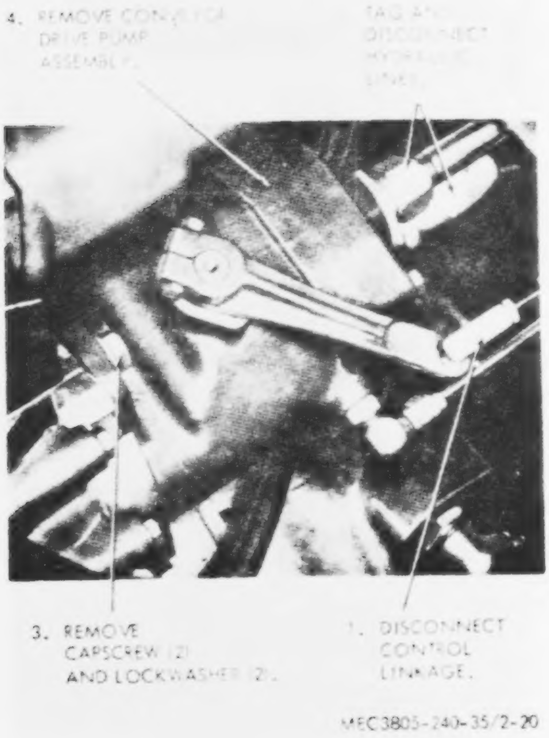

4. REMOVE CONVEYOR DRIVE PUMP ASSEMBLY.
TAG AND DISCONNECT HYDRAULIC LINES.
3. REMOVE CAPSCREW (2) AND LOCKWASHER (2).
1. DISCONNECT CONTROL LINKAGE.
MEC3805-240-35/2-20

Figure 2-20. Conveyor drive pump assembly, removal and installation.

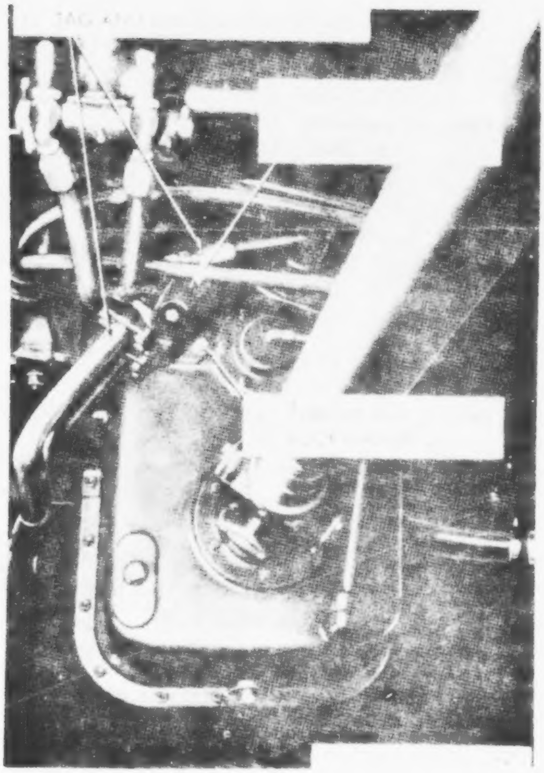


Figure 2-21. Crowd-drive motor, removal and installation.

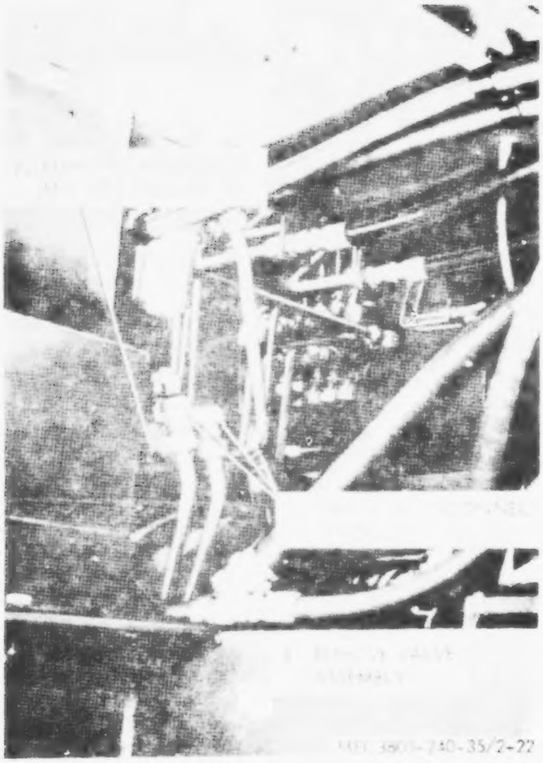

VALVE
ASSEMBLY
MEC 3805-240-35/2-22

Figure 2-22. Relief and replenishing valve, removal and installation.

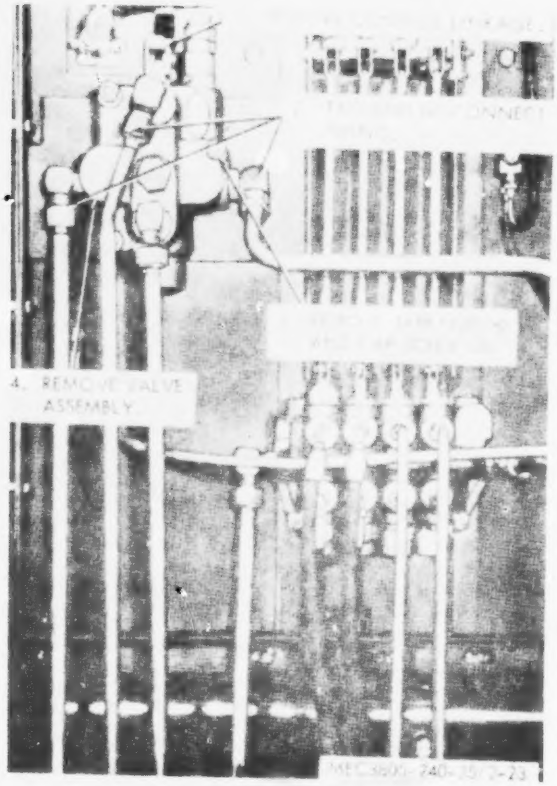
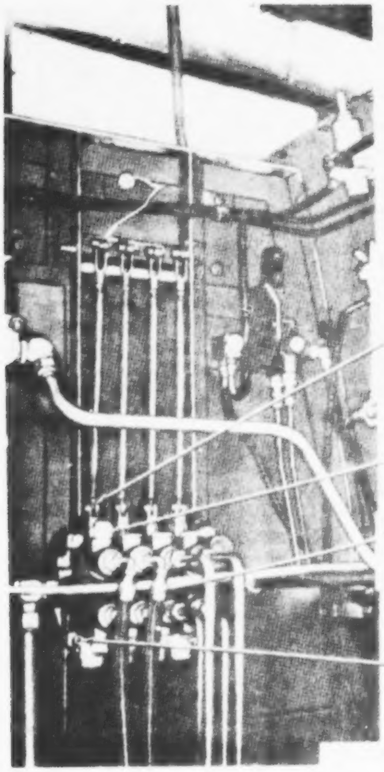

4. REMOVE VALVE ASSEMBLY
MEC 3805-240-35/2-23

Figure 2-23. Conveyor belt-drive directional control valve, removal and installation.



REMOVE COTTER PIN (4) AND DISCONNECT CONTROL LINKAGE (4).

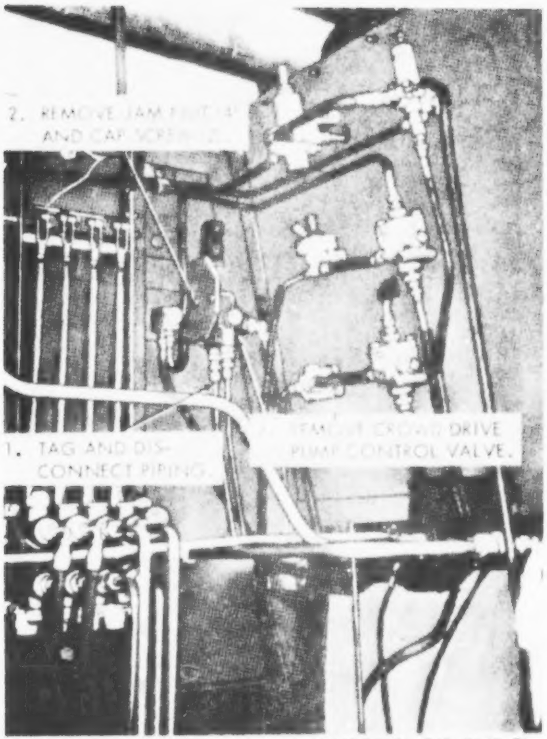
4. REMOVE VALVE ASSEMBLY.

2. TAG AND DISCONNECT PIPING.

3. REMOVE JAM NUT (6) AND CAP-SCREW (3).

240-35/2-24

Figure 2-24. Four-way directional control valve assembly, removal and installation.



2. REMOVE JAM NUT (4) AND CAP SCREW (2).

1. TAG AND DISCONNECT PIPING.

3. REMOVE CROWD DRIVE PUMP CONTROL VALVE.

MEC 3805-240-35/2-25

Figure 2-25. Crowd-pump control valve, removal and installation.

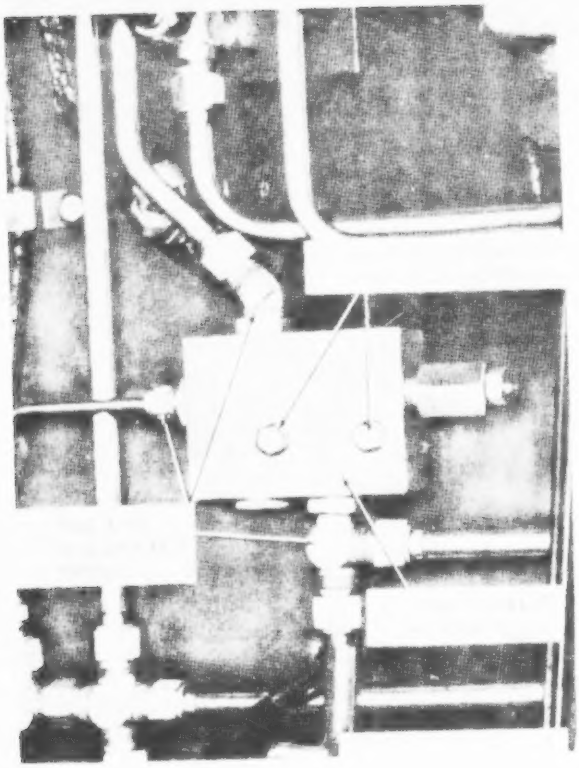
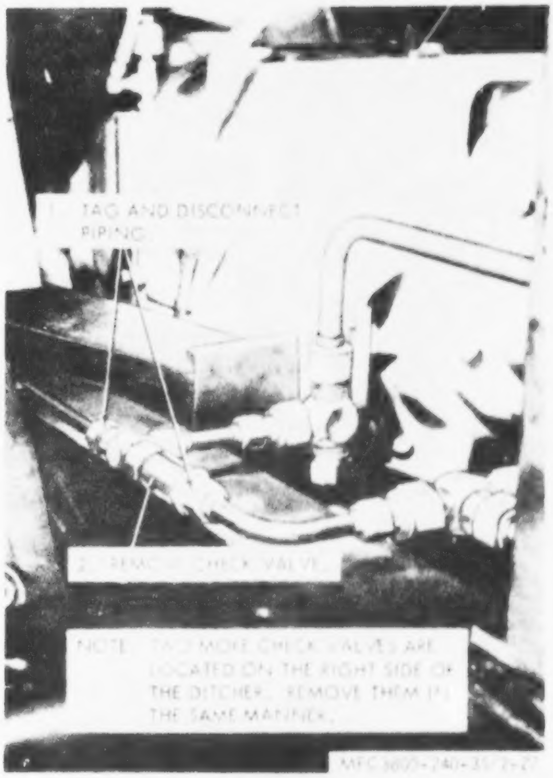


Figure 2-26. Overcenter valve assembly, removal and installation.



1. TAG AND DISCONNECT PIPING.

2. REMOVE CHECK VALVE.

NOTE: TWO MORE CHECK VALVES ARE LOCATED ON THE RIGHT SIDE OF THE DITCHER. REMOVE THEM IN THE SAME MANNER.

MEC 3805-240-35/2-27

Figure 2-27. Check valve, left side, removal and installation.

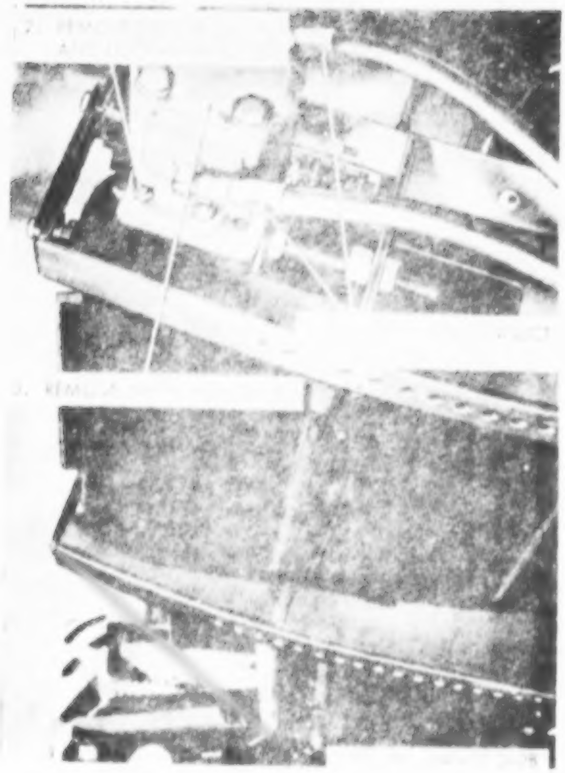


Figure 2-28. Conveyor belt drive motor, removal and installation.

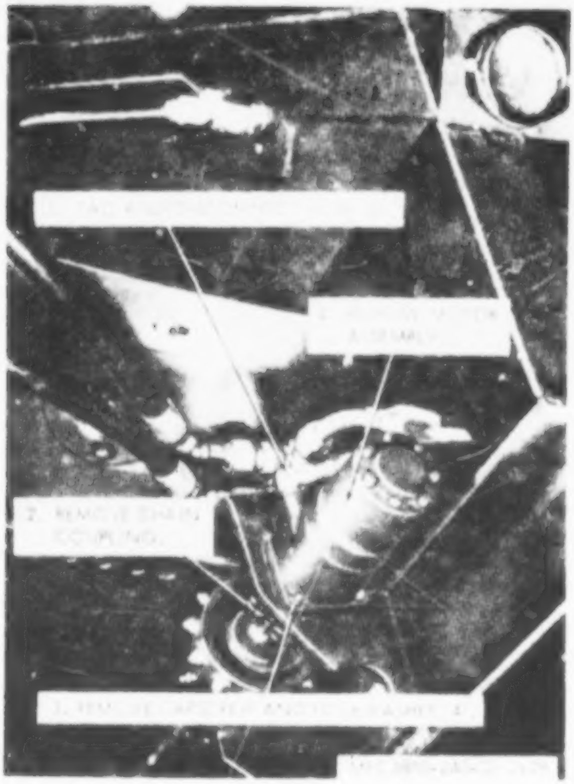

2. REMOVE CHAIN COUPLING.
ASSEMBLY

Figure 2-29. Conveyor shift drive motor assembly, removal and installation.

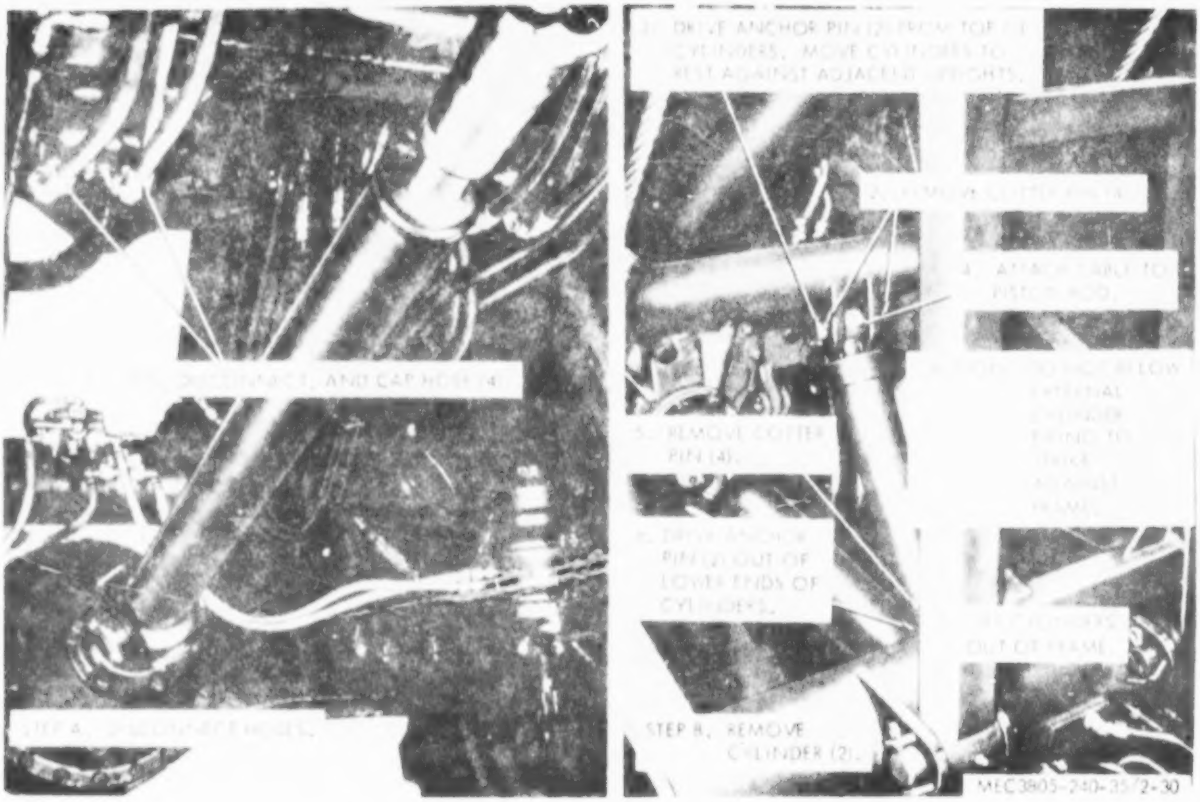

1. DISCONNECT, AND CAP HOSE (4).
STEP A. DISCONNECT HOSES.
3. DRIVE ANCHOR PIN (2) FROM TOP OF CYLINDERS. MOVE CYLINDERS TO REST AGAINST ADJACENT UPRIGHTS.
2. REMOVE COTTER PIN (4).
4. ATTACH CABLE TO PISTON ROD.
CAUTION: DO NOT ALLOW EXTERNAL CYLINDER RINGS TO STRIKE AGAINST FRAME.
5. REMOVE COTTER PIN (4).
6. DRIVE ANCHOR PIN (2) OUT OF LOWER ENDS OF CYLINDERS.
7. LIFT CYLINDERS OUT OF FRAME.
STEP B. REMOVE CYLINDER (2).
MEC3805-240-35/2-30

Figure 2-30. Boom guide cylinder assembly, removal and installation.

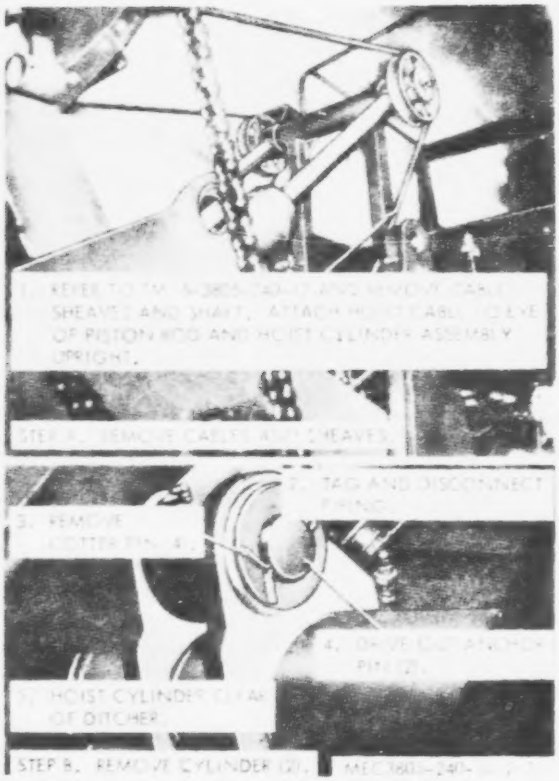
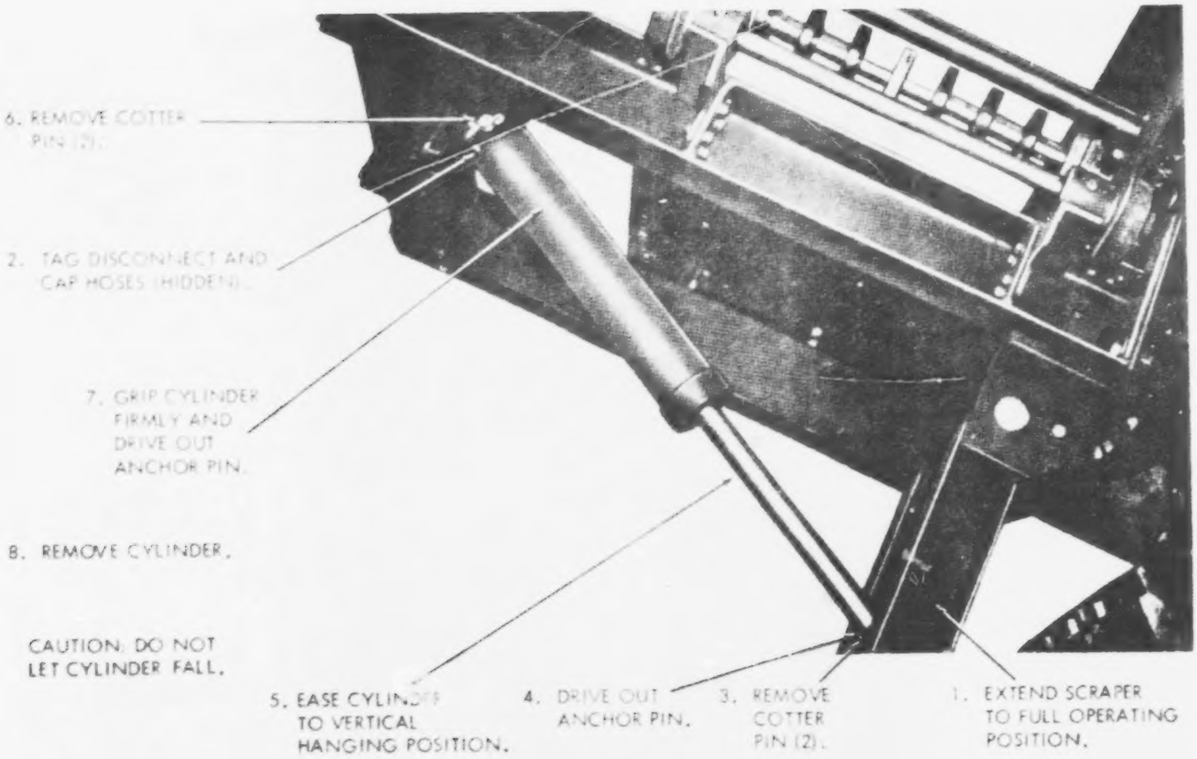

1. REFER TO TM 5-3805-240-12 AND REMOVE CABLE SHEAVES AND SHAFT. ATTACH HOIST CABLE TO EYE OF PISTON ROD AND HOIST CYLINDER ASSEMBLY UPRIGHT.
STEP A. REMOVE CABLES AND SHEAVES.
2. TAG AND DISCONNECT PIPING.
3. REMOVE COTTER PIN (4).
4. DRIVE OUT ANCHOR PIN (2).
5. HOIST CYLINDER CLEAR OF DITCHER.
STEP B. REMOVE CYLINDER (2).
MEC 3805-240-

Figure 2-31. Boom-hoist cylinders, removal and installation.


6. REMOVE COTTER PIN (2).
2. TAG DISCONNECT AND CAP HOSES (HIDDEN).
7. GRIP CYLINDER FIRMLY AND DRIVE OUT ANCHOR PIN.
8. REMOVE CYLINDER.
CAUTION: DO NOT LET CYLINDER FALL.
5. EASE CYLINDER TO VERTICAL HANGING POSITION.
4. DRIVE OUT ANCHOR PIN.
3. REMOVE COTTER PIN (2).
1. EXTEND SCRAPER TO FULL OPERATING POSITION.

MEC 3805-240-35/2-32

Figure 2-32. Follow-up scraper cylinder, removal and installation.

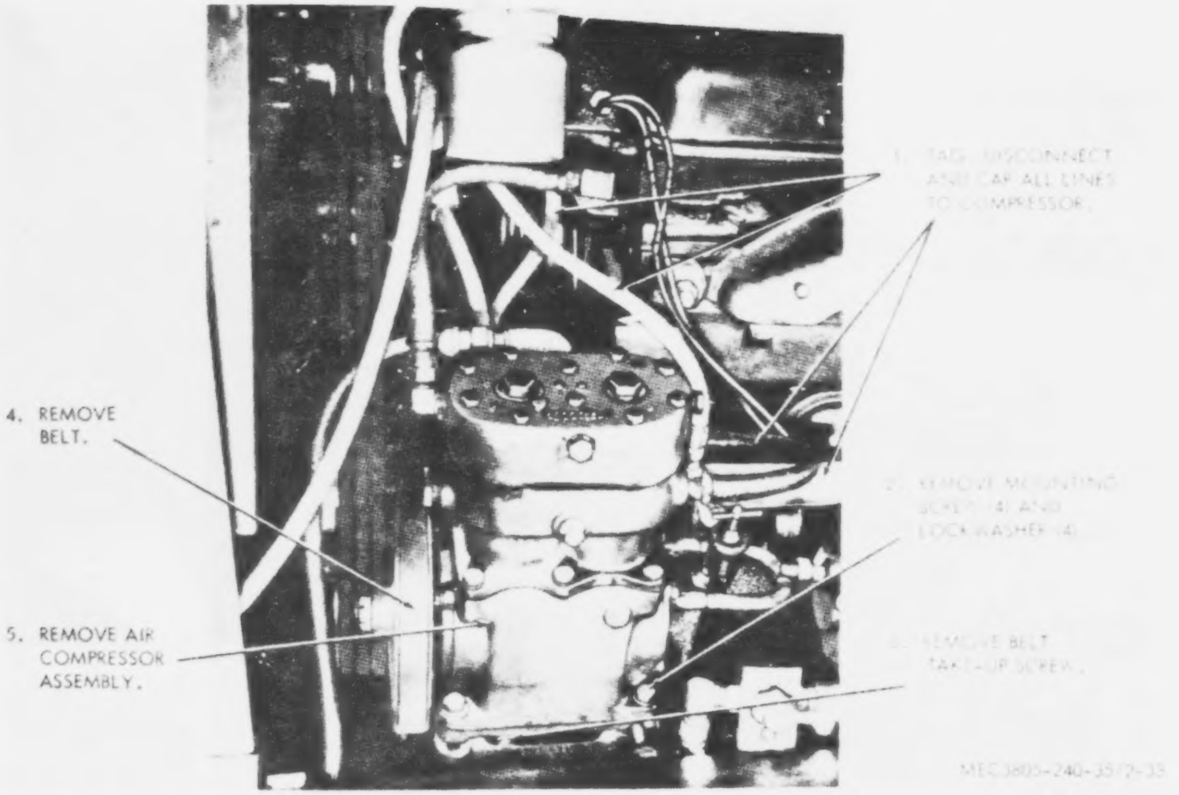

1. TAG, DISCONNECT AND CAP ALL LINES TO COMPRESSOR.
2. REMOVE MOUNTING SCREW (4) AND LOCKWASHER (4).
3. REMOVE BELT TAKE-UP SCREW.
4. REMOVE BELT.
5. REMOVE AIR COMPRESSOR ASSEMBLY.
MEC3805-240-35/2-33

Figure 2-33. Aircompressor, removal and installation.

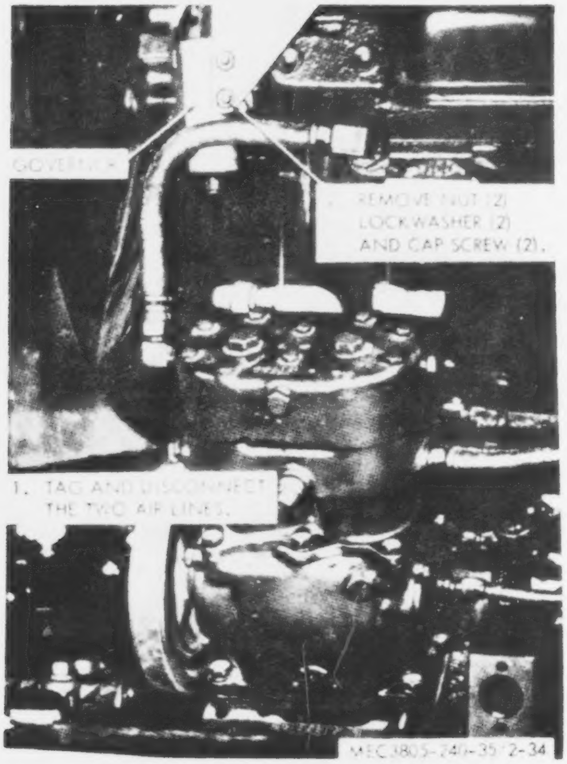
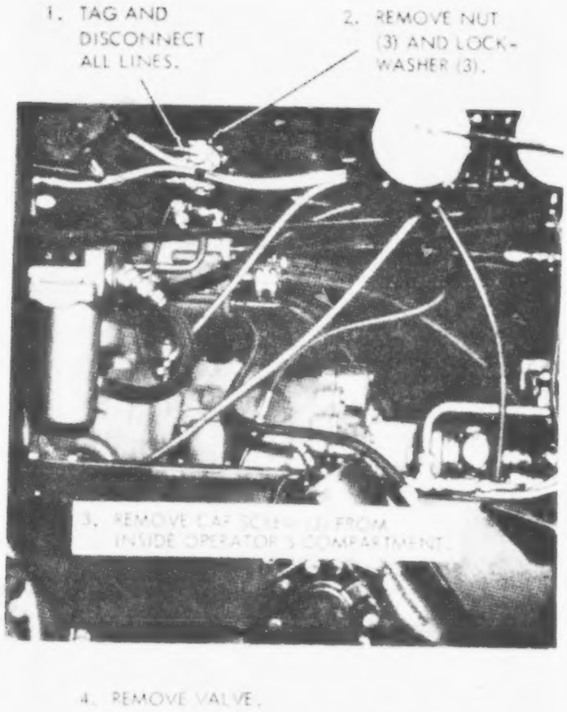

GOVERNOR
REMOVE NUT (2)
LOCKWASHER (2)
AND CAP SCREW (2).
1. TAG AND DISCONNECT
THE TWO AIR LINES.
MEC3805-240-35/2-34

Figure 2-34. Air system governor, removal and installation.


1. TAG AND DISCONNECT ALL LINES.
2. REMOVE NUT (3) AND LOCK-WASHER (3).
3. REMOVE CAP SCREW (3) FROM INSIDE OPERATOR'S COMPARTMENT.
4. REMOVE VALVE.

MEC3805-240-35/2-35

Figure 2-35. Brake valve, removal and installation.

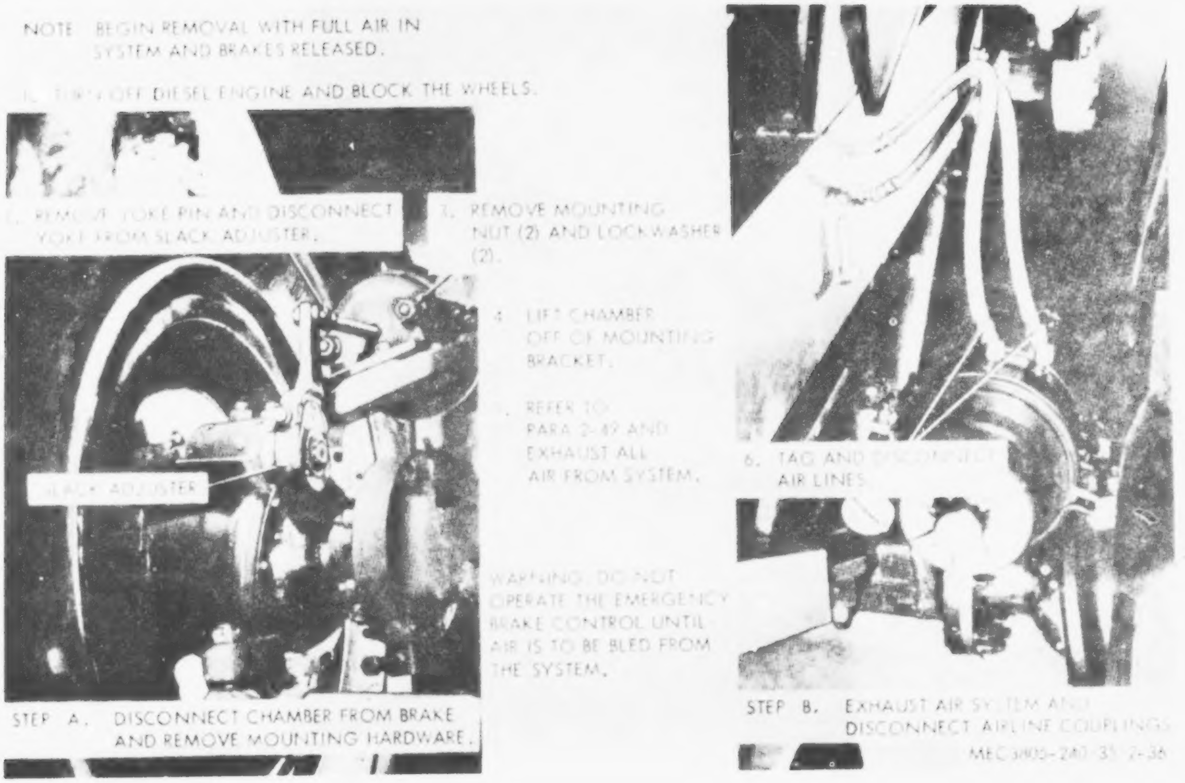

NOTE: BEGIN REMOVAL WITH FULL AIR IN SYSTEM AND BRAKES RELEASED.
1. TURN OFF DIESEL ENGINE AND BLOCK THE WHEELS.
2. REMOVE YOKE PIN AND DISCONNECT YOKE FROM SLACK ADJUSTER.
3. REMOVE MOUNTING NUT (2) AND LOCKWASHER (2).
4. LIFT CHAMBER OFF OF MOUNTING BRACKET.
5. REFER TO PARA 2-49 AND EXHAUST ALL AIR FROM SYSTEM.
SLACK ADJUSTER
WARNING: DO NOT OPERATE THE EMERGENCY BRAKE CONTROL UNTIL AIR IS TO BE BLED FROM THE SYSTEM.
STEP A. DISCONNECT CHAMBER FROM BRAKE AND REMOVE MOUNTING HARDWARE.
6. TAG AND DISCONNECT AIR LINES.
STEP B. EXHAUST AIR SYSTEM AND DISCONNECT AIRLINE COUPLINGS
MEC 3805-240-35/2-36

Figure 2-36. Air brake chamber, removal and installation.

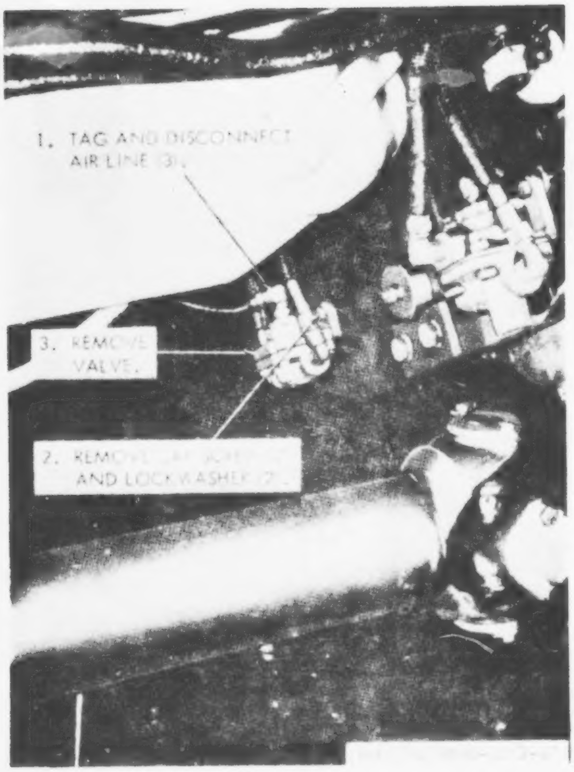

1. TAG AND DISCONNECT AIR LINE (3).
3. REMOVE VALVE.
2. REMOVE CAP SCREW (1) AND LOCKWASHER (2).

Figure 2-37. Quick-release valve, removal and installation.

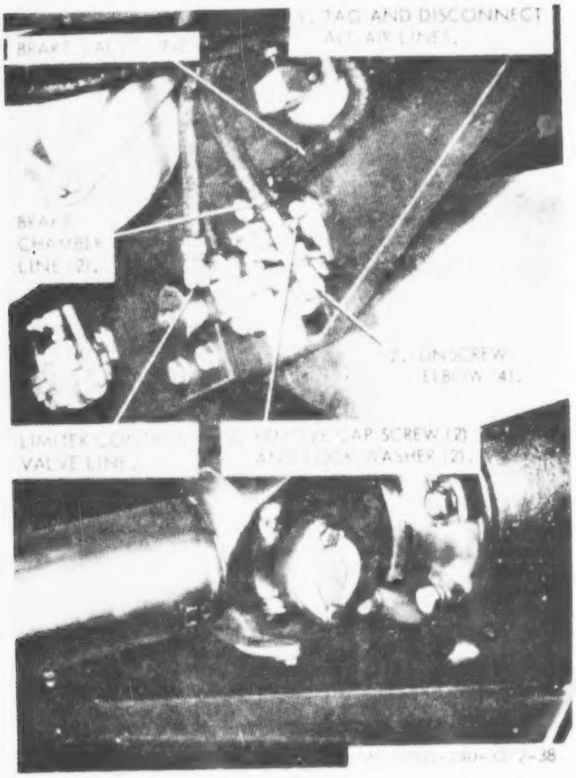

1. TAG AND DISCONNECT ALL AIR LINES.
BRAKE VALVE LINE.
BRAKE CHAMBER LINE (2).
2. UNSCREW ELBOW (4).
LIMITER CONTROL VALVE LINE.
3. REMOVE CAP SCREW (2) AND LOCK WASHER (2).
ME 3805-240-35/2-38

Figure 2-38. Limiting and quick-release valve, removal and installation.

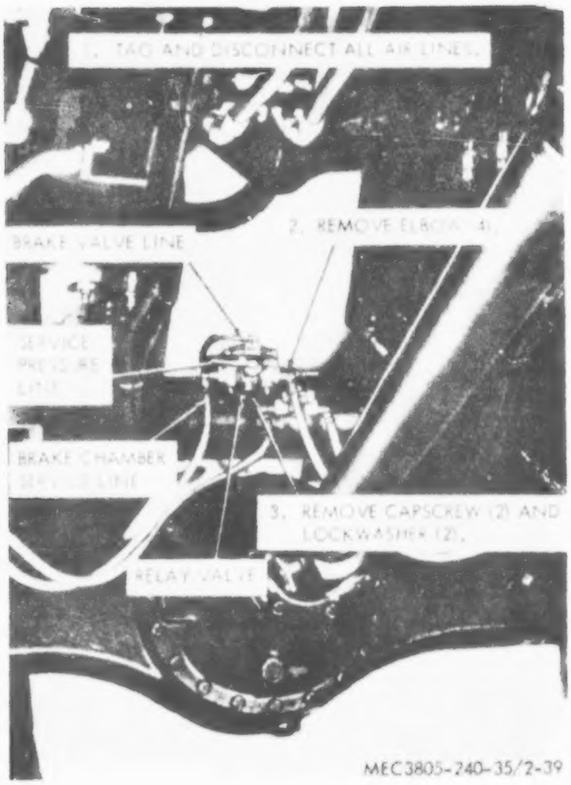
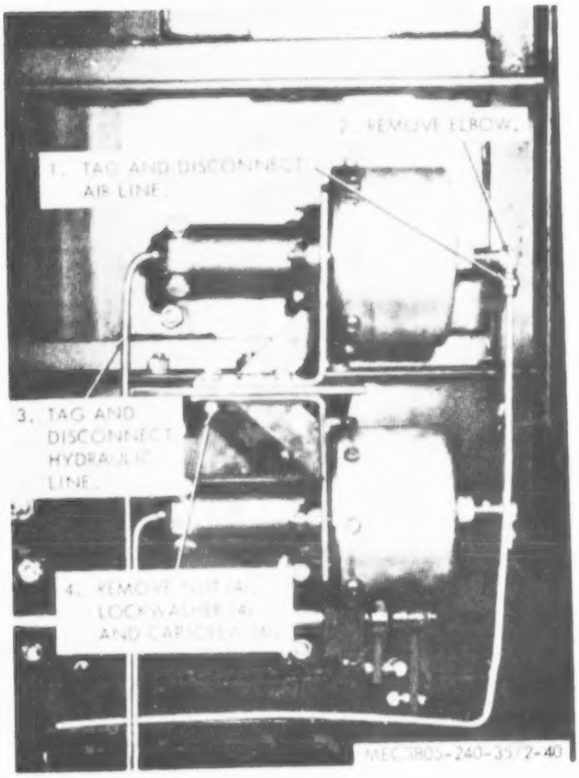

1. TAG AND DISCONNECT ALL AIR LINES.
2. REMOVE ELBOW (4).
BRAKE VALVE LINE
SERVICE PRESSURE LINE
BRAKE CHAMBER SERVICE LINE
3. REMOVE CAPSCREW (2) AND LOCKWASHER (2).
RELAY VALVE
MEC3805-240-35/2-39

Figure 2-39. Relay valve, removal and installation.



1. TAG AND DISCONNECT AIR LINE.

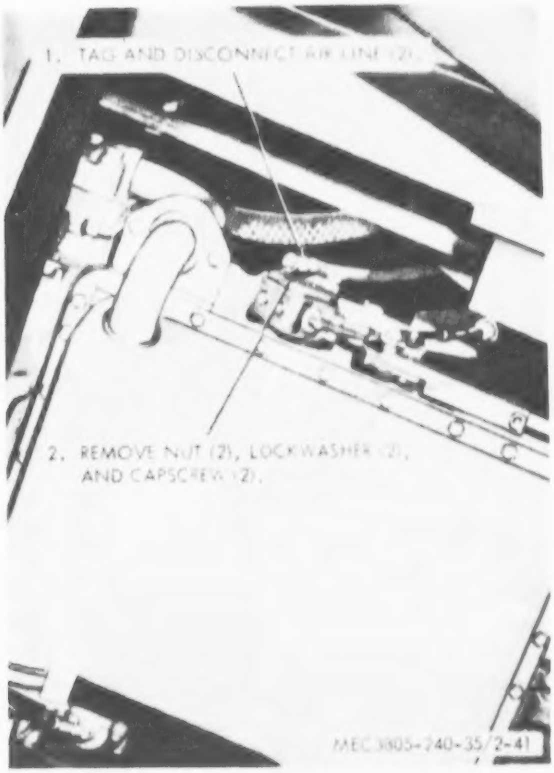
2. REMOVE ELBOW.

3. TAG AND DISCONNECT HYDRAULIC LINE.

4. REMOVE NUT (4), LOCKWASHER (4) AND CAPSCREW (4).

MEC 3805-240-35/2-40

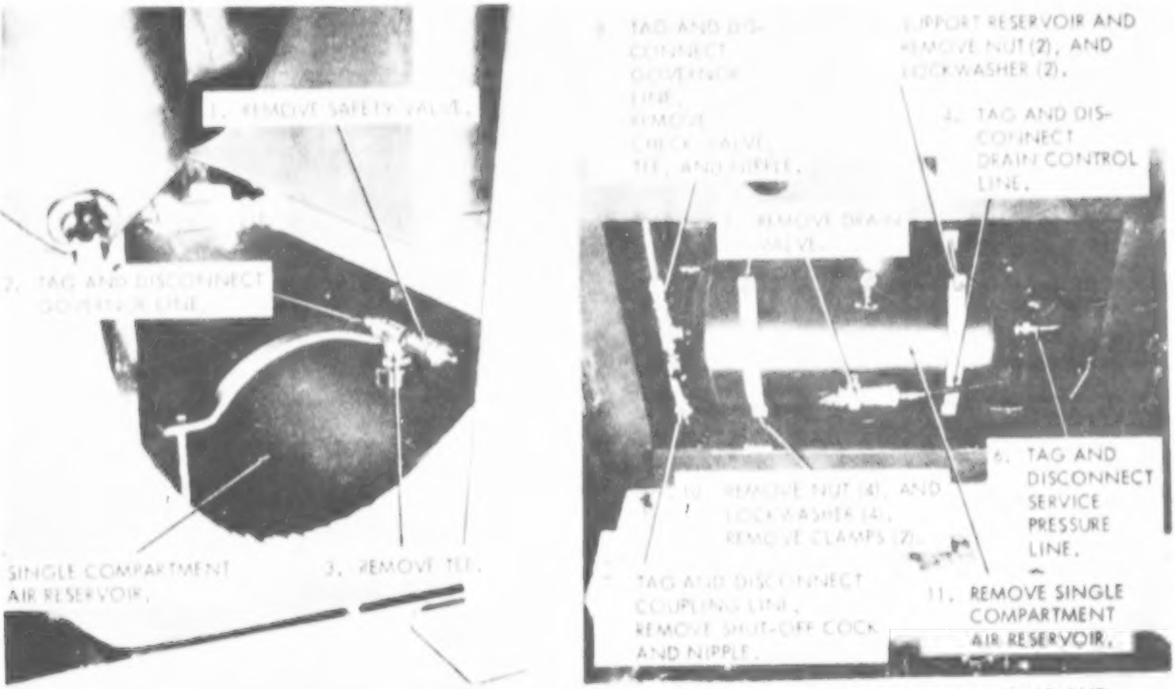
Figure 2-40. Power cluster assembly, removal and installation.


1. TAG AND DISCONNECT AIR LINE (2).

2. REMOVE NUT (2), LOCKWASHER (2), AND CAPSCREW (2).

MEC 3805-240-35/2-41

Figure 2-41. Pilot air valve, removal and installation.


1. REMOVE SAFETY VALVE.
2. TAG AND DISCONNECT GOVERNOR LINE.
SINGLE COMPARTMENT AIR RESERVOIR.
3. REMOVE TEE.
8. TAG AND DISCONNECT GOVERNOR LINE, REMOVE CHECK VALVE, TEE, AND NIPPLE.
SUPPORT RESERVOIR AND REMOVE NUT (2), AND LOCKWASHER (2).
4. TAG AND DISCONNECT DRAIN CONTROL LINE.
5. REMOVE DRAIN VALVE.
6. TAG AND DISCONNECT SERVICE PRESSURE LINE.
10. REMOVE NUT (4), AND LOCKWASHER (4), REMOVE CLAMPS (2).
7. TAG AND DISCONNECT COUPLING LINE, REMOVE SHUT-OFF COCK AND NIPPLE.
11. REMOVE SINGLE COMPARTMENT AIR RESERVOIR.

STEP A. REMOVE UPPER PLUMBING.

STEP B. DISCONNECT LOWER PLUMBING AND REMOVE RESERVOIR.

MEC3805-240-35/2-42

Figure 2-42. Single compartment air reservoir, removal and installation.

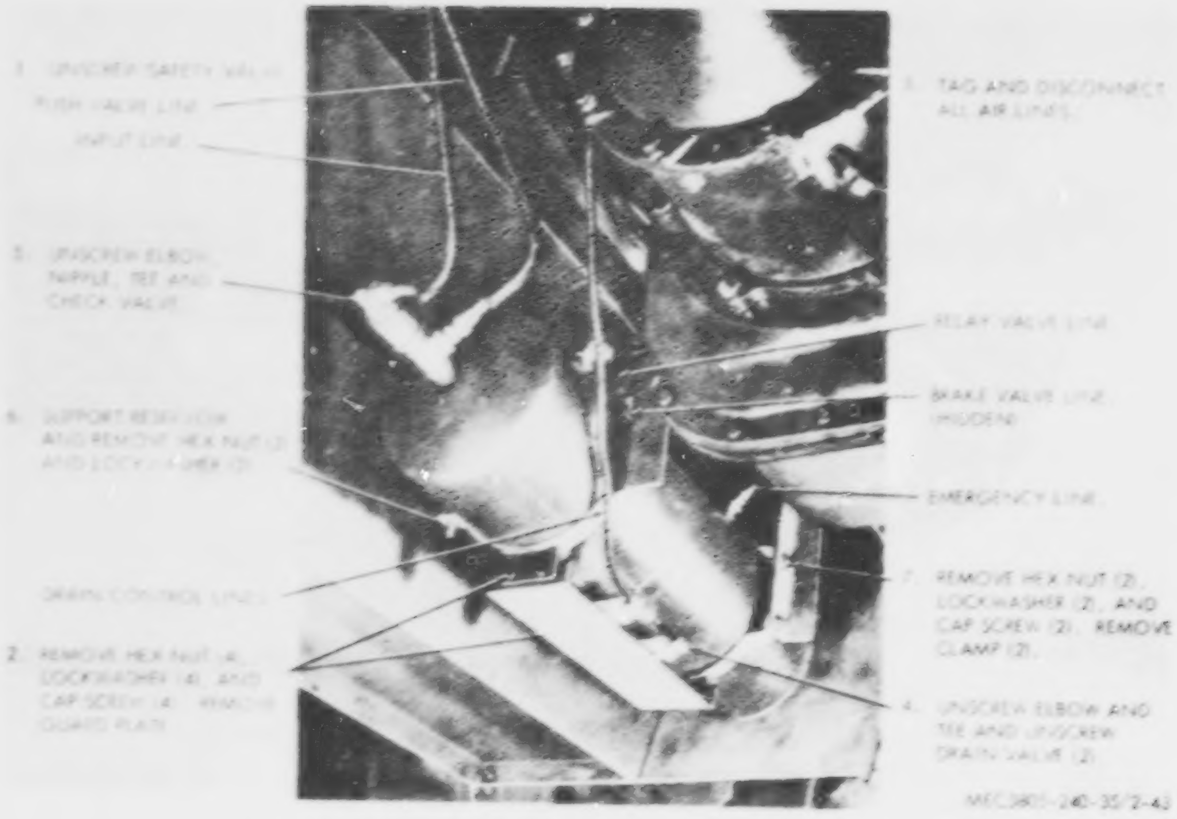

3. UNSCREW SAFETY VALVE
PUSH VALVE LINE
INPUT LINE
5. UNSCREW ELBOW, NIPPLE, TEE AND CHECK VALVE
6. SUPPORT RESERVOIR AND REMOVE HEX NUT (2) AND LOCKWASHER (2)
DRAIN CONTROL LINES
2. REMOVE HEX NUT (4), LOCKWASHER (4), AND CAP SCREW (4). REMOVE GUARD PLATE
1. TAG AND DISCONNECT ALL AIR LINES.
RELAY VALVE LINE
BRAKE VALVE LINE (HIDDEN)
EMERGENCY LINE
7. REMOVE HEX NUT (2), LOCKWASHER (2), AND CAP SCREW (2). REMOVE CLAMP (2).
4. UNSCREW ELBOW AND TEE AND UNSCREW DRAIN VALVE (2)
MEC3805-240-35/2-43

Figure 2-43. Double-compartment air reservoir, removal and installation.

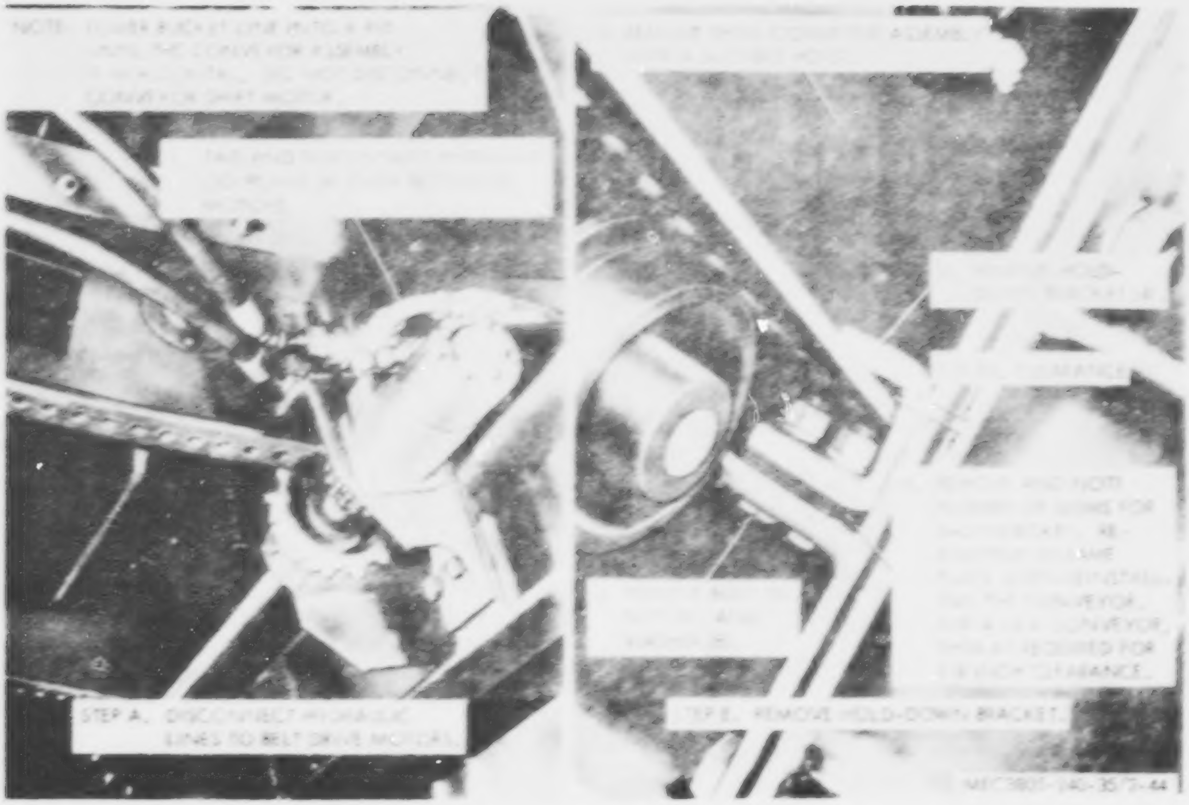

NOTE:
STEP A. DISCONNECT HYDRAULIC LINES TO BELT DRIVE MOTORS.
STEP B. REMOVE HOLD-DOWN BRACKET.
MEC 3805-240-35/2-44

Figure 2-44. Conveyor assembly, removal and installation.

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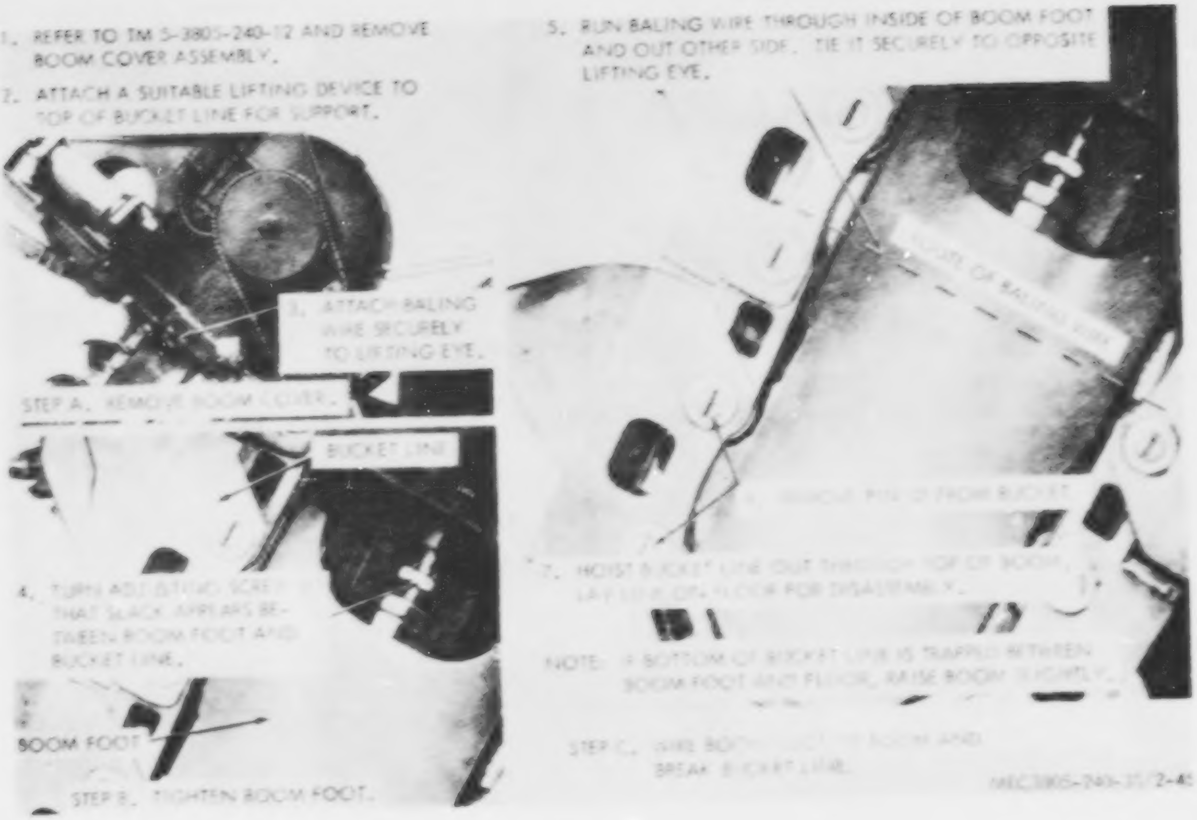

1. REFER TO TM 5-3805-240-12 AND REMOVE BOOM COVER ASSEMBLY.
2. ATTACH A SUITABLE LIFTING DEVICE TO TOP OF BUCKET LINE FOR SUPPORT.
3. ATTACH BALING WIRE SECURELY TO LIFTING EYE.
STEP A. REMOVE BOOM COVER.
BUCKET LINE
4. TURN ADJUSTING SCREW SO THAT SLACK APPEARS BETWEEN BOOM FOOT AND BUCKET LINE.
BOOM FOOT
STEP B. TIGHTEN BOOM FOOT.
5. RUN BALING WIRE THROUGH INSIDE OF BOOM FOOT AND OUT OTHER SIDE. TIE IT SECURELY TO OPPOSITE LIFTING EYE.
ROUTE OF BALING WIRE
6. REMOVE PIN [illegible] FROM BUCKET.
7. HOIST BUCKET LINE OUT THROUGH TOP OF BOOM. LAY LINE ON FLOOR FOR DISASSEMBLY.
NOTE: IF BOTTOM OF BUCKET LINE IS TRAPPED BETWEEN BOOM FOOT AND FLOOR, RAISE BOOM SLIGHTLY.
STEP C. WIRE BOOM FOOT TO BOOM AND BREAK BUCKET LINE.
MEC3805-240-35/2-45

Figure 2-45. Bucket line, removal and installation.

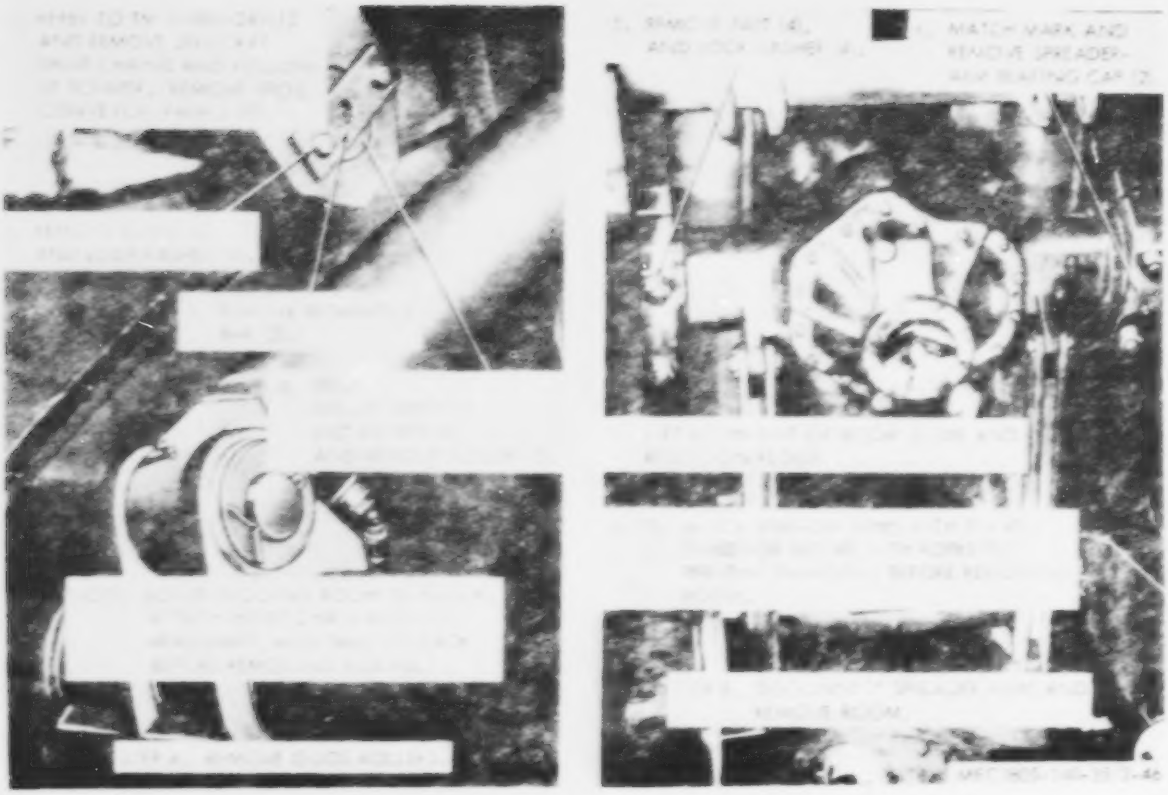
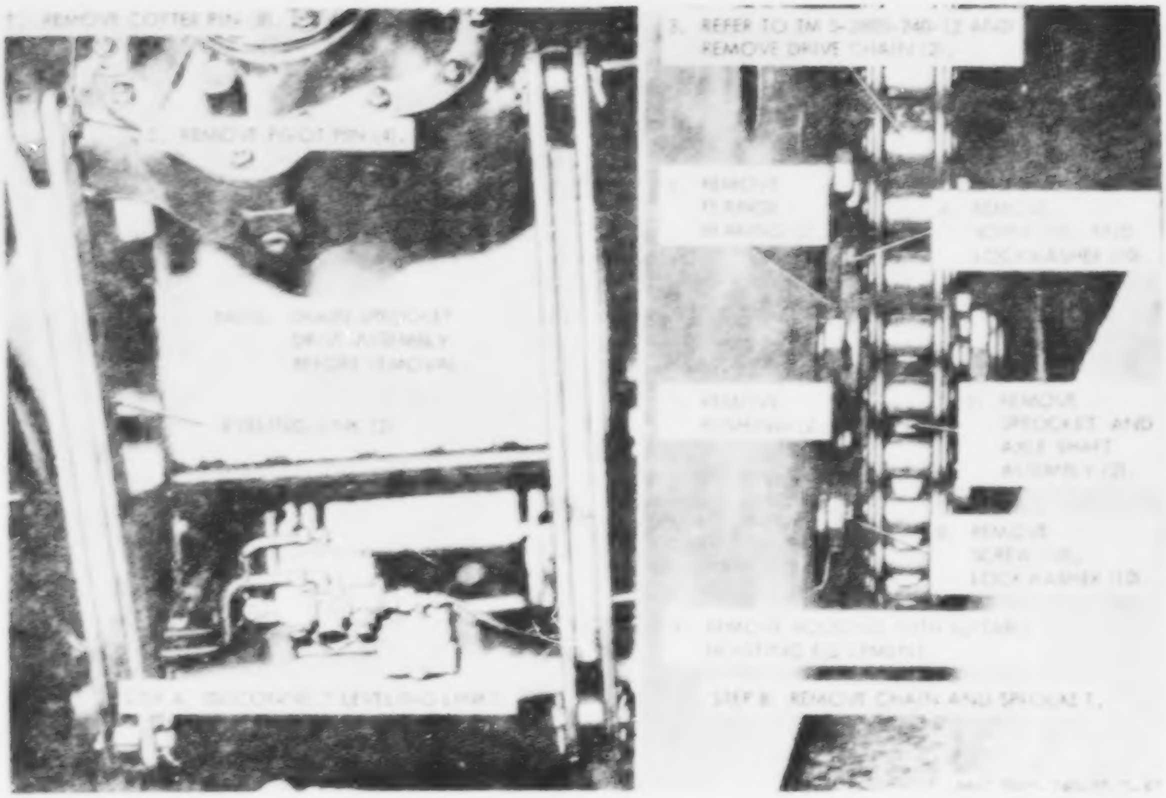

REMOVE NUT (4) AND LOCK WASHER (4).
MATCH MARK AND REMOVE SPREADER-ARM BEARING CAP (2).
REMOVE BOOM.
MEC 3805-240-35/2-46

Figure 2-46. Digging boom, removal and installation.



1. REMOVE COTTER PIN (8).
2. REMOVE PIVOT PIN (4).
NOTE: CHAIN SPROCKET DRIVE ASSEMBLY BEFORE REMOVAL
LEVELING LINK (2)
STEP A. DISCONNECT LEVELING LINK.
3. REFER TO TM 5-3805-240-12 AND REMOVE DRIVE CHAIN (2).
REMOVE FLANGE BEARING
4. REMOVE SCREW AND LOCKWASHER
REMOVE BUSHING
REMOVE SPROCKET AND AXLE SHAFT ASSEMBLY (2).
REMOVE SCREW, LOCKWASHER
REMOVE HOUSING WITH SUITABLE HOISTING EQUIPMENT.
STEP B. REMOVE CHAIN AND SPROCKET.

Figure 2-47. Right-angle sprocket-drive assembly, removal and installation.

CHAPTER 3

ENGINE REPAIR INSTRUCTIONS

Section I. COOLING COMPONENTS

3-1. General

a. The cooling system maintains the proper engine operating temperature by means of a radiator, water pump, two thermostats, and a fan assembly.

b. Refer to section VII for water pump repair instructions.

c. Refer to TM 5-3805-240-12 for thermostat repair instructions.

3-2. Radiator Assembly

a. General. The radiator assembly consists of an upper water tank, water pressure control cap, core, lower water tank, two vertical side members, gaskets, hoses, clamps, mounting screws, and pads. A separate oil cooler core for hydraulic fluid is mounted on the front of the radiator assembly. The fan shroud is fastened to the back of the radiator assembly.

b. Removal. Remove radiator assembly (para 2-40).

c. Testing.

(1) Disassemble the radiator in the numerical sequence as illustrated on figure 3-1, removing only the hoses, clamps, fan shroud, and oil cooler.

(2) Refer to TM 10-450 and test the radiator for clogging or leaks.

d. Disassembly. Disassemble the radiator in the numerical sequence as illustrated on figure 3-1.

e. Cleaning. Refer to TM 10-450 and clean the radiator.

f. Inspection and Repair. Refer to TM 10-450 and inspect and repair the radiator.

g. Reassembly. Reassemble the radiator in reverse of numerical sequence as illustrated on figure 3-1.

h. Installation. Install radiator (para 2-40).

3-3. Fan Assembly

a. General. The fan pulls air through the radiator core to insure adequate cooling, especially when the ditcher is moving very slowly. The fan is belt-driven from a pulley on the front of the engine crankshaft.

b. Removal. Refer to paragraph 2-40 and remove the fan.

c. Disassembly. Disassemble fan in the numerical sequence as illustrated on figure 3-2.

d. Cleaning. Clean the fan and related parts with clean fuel oil, and dry them with compressed air.

e. Inspection and Repair.

(1) Examine the bearings (23 and 24, fig. 3-2) for any indications of corrosion or pitting. Hold the inner race so it does not run and revolve the outer race slowly by hand. If rough spots are found, replace the bearings.

(2) Check the fan blades (16); if the blades are cracked or bent, replace them.

(3) Look for cracks in the adjusting and support bracket castings (5 and 12).

f. Reassembly.

(1) Reassemble fan in reverse of numerical sequence as illustrated on figure 3-2.

(2) Pack the cavity in the pulley hub (21) half full of all purpose grease before pressing the pulley hub onto the fan shaft (26).

(3) Tighten the nut (20) to 60-90 ft-lbs. torque.

(4) Pack the front cavity of the pulley hub (21) half full of all purpose grease and install a new hub cap.

(5) Tighten the six fan-to-hub bolts (13) to 15-19 ft-lbs. torque.

g. Installation. Refer to paragraph 2-40 and install the fan.

MEC 3805-240-35/3-1

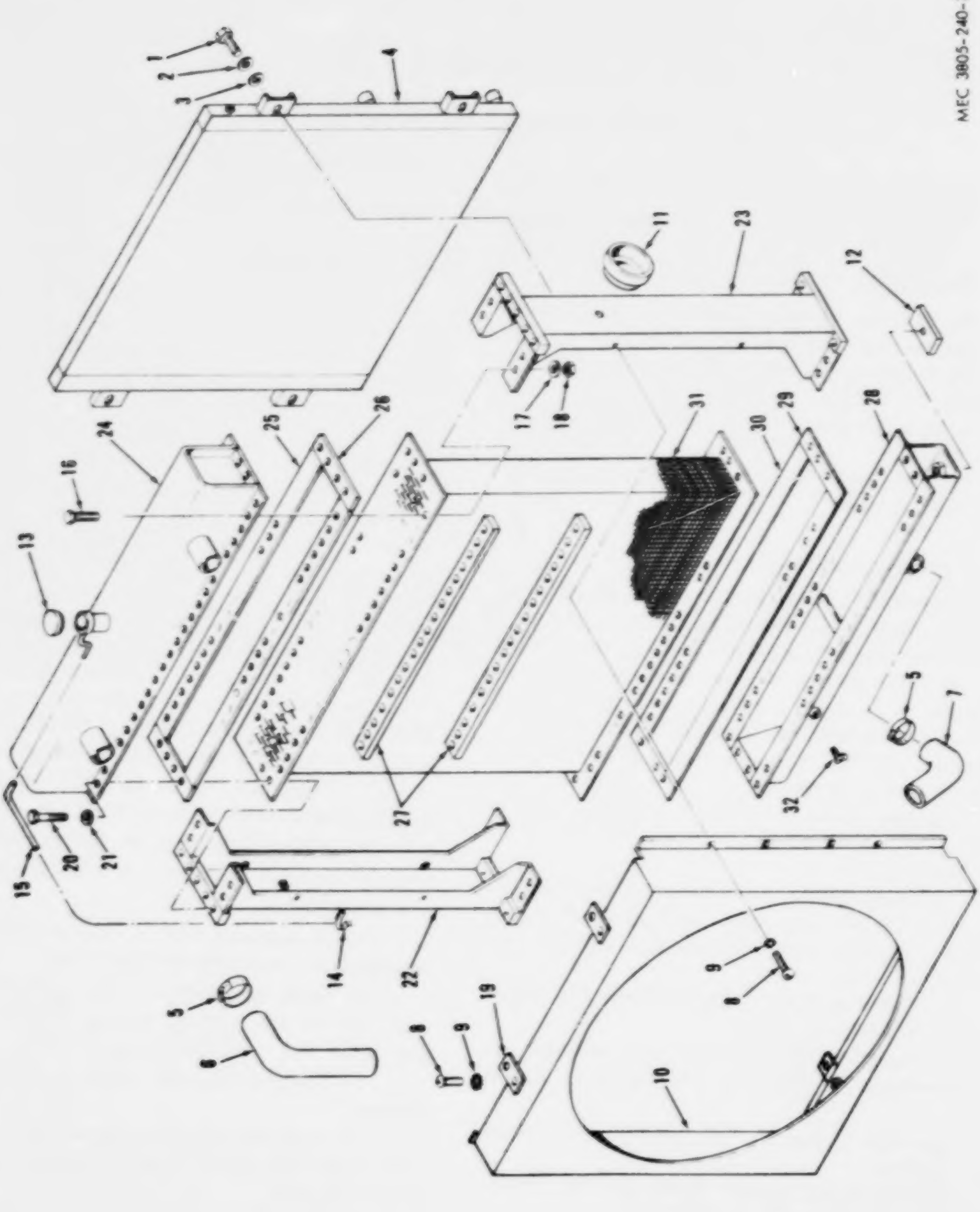

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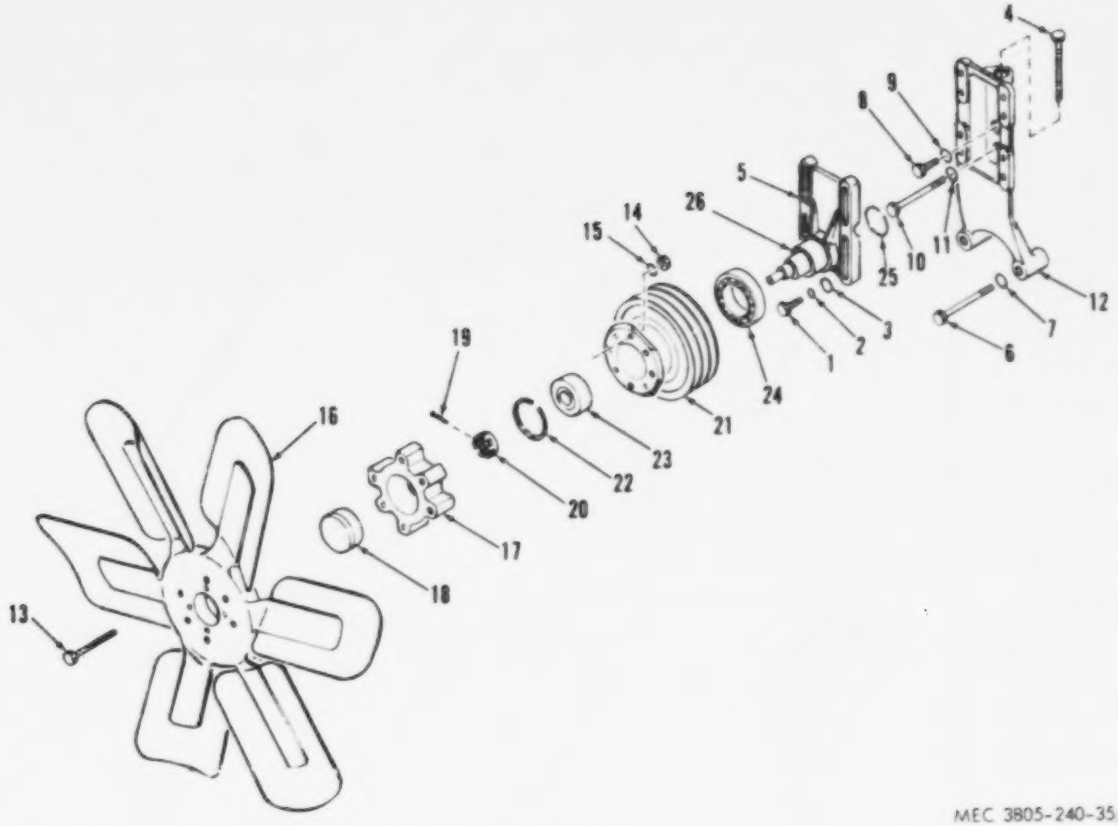
Figure 3-1. Radiator and shroud assembly, exploded view.

1 Bolt, 5/16–18 x 3/4 in. (4 rqr)
2 Lockwasher, 5/16 in. (4 rqr)
3 Washer, 5/16 in. (4 rqr)
4 Oil cooler assembly
5 Hose clamp (6 rqr)
6 Hose, upper (2 rqr)
7 Hose, lower
8 Screw, 1/4–20 x 3/8 in. (12 rqr)
9 Lockwasher, 1/4 in. (12 rqr)
10 Shroud assembly
11 Vibration damper (2 rqr)
12 Absorber pad (2 rqr)
13 Cap
14 Overflow clip (2 rqr)
15 Overflow tube
16 Bolt, 5/16–18 x 7/8 in. (68 rqr)
17 Lockwasher, 5/16 in. (68 rqr)
18 Nut, 5/16–18 (68 rqr)
19 Shroud clip (4 rqr)
20 Bolt, 5/16–18 x 3/4 in. (20 rqr)
21 Lockwasher, 5/16 in. (20 rqr)
22 Side member, left hand
23 Side member, right hand
24 Top tank assembly
25 Gasket, long (2 rqr)
26 Gasket, short (2 rqr)
27 Core washer (4 rqr)
28 Bottom tank assembly
29 Gasket, short (2 rqr)
30 Gasket, long (2 rqr)
31 Core assembly
32 Draincock

Figure 3–1—Continued



MEC 3805-240-35/3-2

1 Bolt, 1/2-13 x 1-1/2 in. (4 rqr)
2 Lockwasher, 1/2 in. (4 rqr)
3 Washer, special (4 rqr)
4 Bolt, 1/2-13 x 5 in.
5 Adjusting bracket assembly
6 Bolt, 5/8-11 x 5 in. (2 rqr)
7 Lockwasher, 5/8 in. (2 rqr)
8 Bolt, 5/8-11 x 2-1/4 in.
9 Lockwasher, 5/8 in.
10 Bolt, 1/2-13 x 4-3/4 in.
11 Lockwasher, 1/2 in.
12 Fan support
13 Bolt, 5/16-24 x 2-3/8 in. (6 rqr)
14 Nut, 5/16-24 (6 rqr)
15 Lockwasher, 5/16 in. (6 rqr)
16 Fan assembly
17 Spacer
18 Hub cap
19 Cotter pin
20 Castle nut
21 Hub assembly
22 Retaining ring
23 Bearing
24 Bearing
25 Retaining ring
26 Fan shaft

Figure 3-2. Fan and support assembly, exploded view.

Section II. ALTERNATOR ASSSEMBLY

3-4. General

The 24 volt alternator is a self-rectifying, self load limiting unit which provides a source of electrical current to keep the batteries charged and carry any other electrical loads up to 30 amperes. The alternator is anti-fungus and corrosion treated.

3-5. Testing

Refer to TM 5-3805-240-12 and test the alternator.

3-6. Removal

Refer to TM 5-3805-240-12 and remove the alternator.

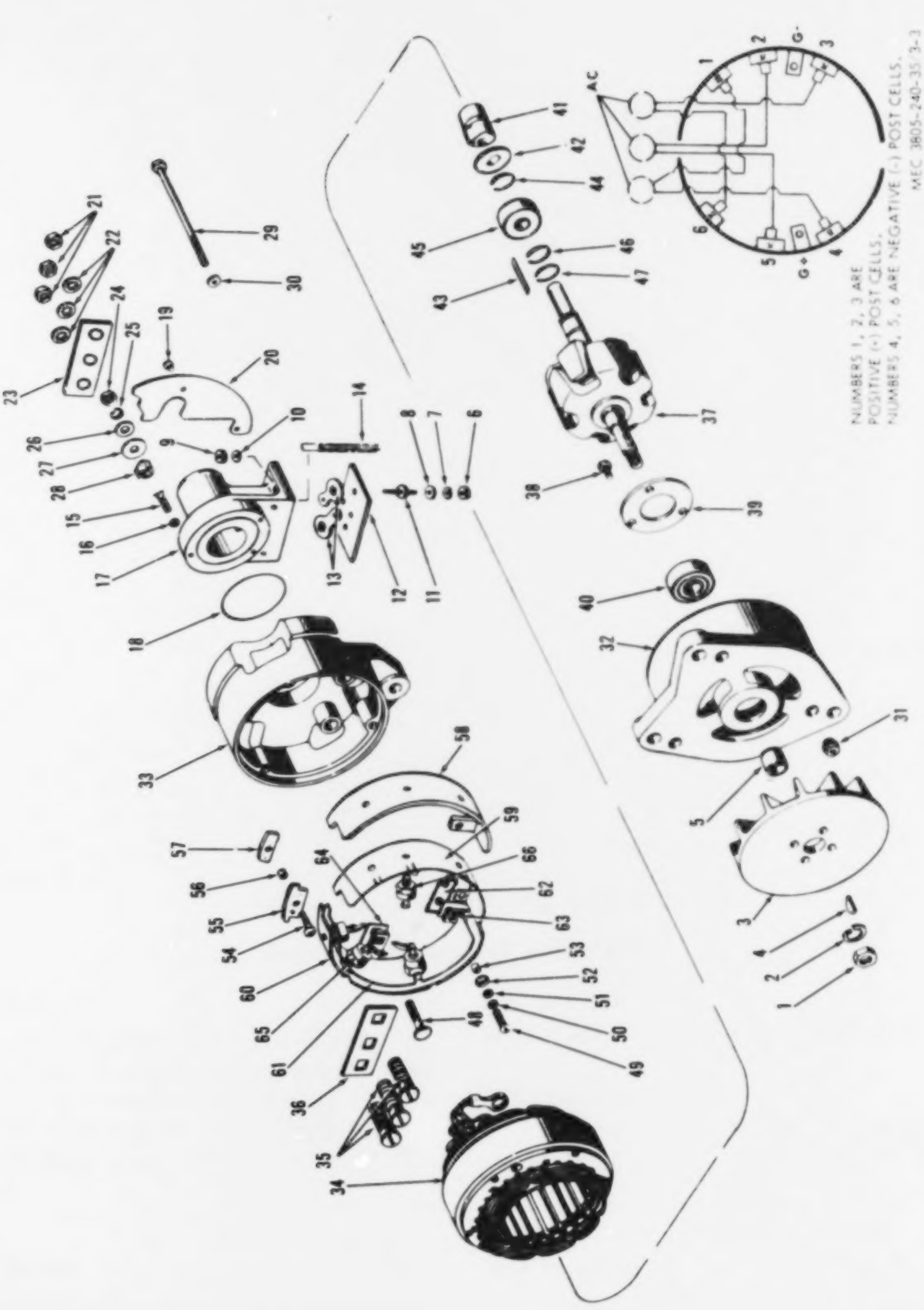
3-7. Disassembly

a. If testing indicates trouble within the alternator, disassemble the alternator in the numerical sequence as illustrated on figure 3-3.

b. Disassemble the alternator only as far as required to make the necessary repairs.

3-8. Cleaning

a. Remove loose dirt or carbon dust with clean, dry compressed air.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NUMBERS 1, 2, 3 ARE POSITIVE (+) POST CELLS.
NUMBERS 4, 5, 6 ARE NEGATIVE (-) POST CELLS.

MEC 3805-240-35/3-3

Figure 3-2. Alternator assembly, exploded view.

1	Nut, 1/2–20 in.
2	Lockwasher, 1/2 in.
3	Fan assembly
4	Key, No. 6 Woodruff
5	Spacer
6	Nut, 10–24 (2 rqr)
7	Lockwasher, No. 10 (5 rqr)
8	Guard washer (2 rqr)
9	Nut, 10–32 (2 rqr)
10	Lockwasher, No. 10 (2 rqr)
11	Terminal (2 rqr)
12	Insulator cover
13	Jumper (2 rqr)
14	Brush (2 rqr)
15	Screw, 8–32 x 3/4 in. (3 rqr)
16	Lockwasher, No. 8 (3 rqr)
17	Brush holder housing
18	"O" ring
19	Screw, 8–32 x 1/4 in. (6 rqr)
20	Dust shield (2 rqr)
21	Nut, 1/4–20 (5 rqr)
22	Lockwasher, 1/4 (3 rqr)
23	Insulator
24	Nut, 1/4–20 (5 rqr)
25	Lockwasher, 1/4 in. (2 rqr)
26	Guard washer (2 rqr)
27	Insulation washer (2 rqr)
28	Insulation bushing (2 rqr)
29	Screw, special (3 rqr)
30	Washer, No. 10 (3 rqr)
31	Spline nut (3 rqr)
32	Drive end housing
33	Slip ring housing
34	Stator assembly
35	Screw, special (3 rqr)
36	Insulator
37	Rotor assembly
38	Screw 10–32 (3 rqr)
39	Retainer
40	Bearing, 304 NPP
41	Slip ring assembly
42	Insulation washer
43	Slot wedge
44	Snap ring
45	Bearing, 203 PP
46	Snap ring
47	Snap ring
48	Terminal screw (2 rqr)
49	Screw, 8–32 x 5/8 in. (2 rqr)
50	Lockwasher, No. 8 (2 rqr)
51	Guard washer, No. 8 (2 rqr)
52	Insulator (2 rqr)
53	Insulation bushing (2 rqr)
54	Screw, 8–32 x 7/8 in.
55	Insulator
56	Insulation bushing
57	Insulator (bottom)
58	Rect. assembly (pos.)
59	Rect. brkt. (inner)
60	Rect. assembly (neg.)
61	Rect. brkt. (inner)
62	Insulator
63	Insulator
64	Insulator (2 rqr)
65	Silicon rect. (neg.) (3 rqr)
66	Silicon rect. (pos.) (3 rqr)

Figure 3–3—Continued

b. Soak a clean cloth in unleaded gasoline or kerosene and wipe the stator and rotor clean. Dry with compressed air.

***Caution.* Do not dip the stator or rotor in cleaning solvent of any kind. Use a wiping cloth as described above.**

3-9. Inspection and Repair

a. Hold one prod of a 110 volt test lamp on the stator frame and touch each terminal with the other prod. The lamp should not light. Hold one prod at each terminal and, one at a time, check the other two. The lamp should light on all terminals.

b. If the rotor coil circuit is open, grounded, or has the wrong resistance, install a new rotor as follows:

(1) Unsolder rotor coil wires from the outer and inner slip ring. Bend down the wire so it is close to the shaft.

(2) Remove the slip ring assembly and insulation washer. Keep slip rings in a warm place for easier reassembly.

(3) Remove the outer snap ring and pull off the bearing.

(4) After replacing the bearing and snap ring on the rotor shaft, press on the slip ring assembly up to the shoulder. Be sure that the slots line up with the hole where the wires come from the rotor coil.

(5) Solder the rotor coil wires to the slip ring assembly.

(6) Put the rotor in a lathe and take a light, smooth cut from the face of the slip rings to insure concentricity with the shaft bearing surfaces within .022 inches total indicator reading.

c. Replace defective rectifier cells as follows:

(1) Unsolder the wires from the defective cell, being careful to disturb as few wires as possible.

(2) Bend the lock tab down and unscrew the cell from the tapped hole in the bracket.

(3) Clean the area around the cell mounting hole with a wire brush and coat with non-water-soluble grease. If the spacer between the inner and outer brackets slips out, clean and coat both sides with non-water-soluble grease before installing the new cell.

(4) Screw the new cell into the mounting hole and tighten to 20-25 in-lbs. (inch-pounds) torque.

(5) Bend the lock tab up to secure the cell.

(6) Solder the wires to the new cell using only enough heat to insure a good connection. Too much heat can damage the cell.

d. Replace worn or defective brushes (14) as follows:

(1) Using fine sandpaper, sand the carbon ends of new brushes (14) concentric with the slip ring assembly (41).

(2) Insert brushes (14) in housing (17).

(3) Use a putty knife or shim stock to compress brush springs level with housing holes. Install jumpers (13) and insulator cover (12) while keeping brush springs compressed.

(4) Hold the insulator cover (12) in position and install lockwashers (10) and nuts (9) finger tight.

(5) Slip the putty knife or shim stock out of housing (17) and tighten nuts (9) securely.

e. Connect one prod of a 110 volt test lamp to ground and touch the negative (-) and positive (+) terminals one at a time with the other prod. If the test lamp lights a ground is present. Check rectifier bracket mountings at the top, center, and bottom of the slip rings housing to see if all insulator plates, bushings, and washers are properly installed.

3-10. Reassembly

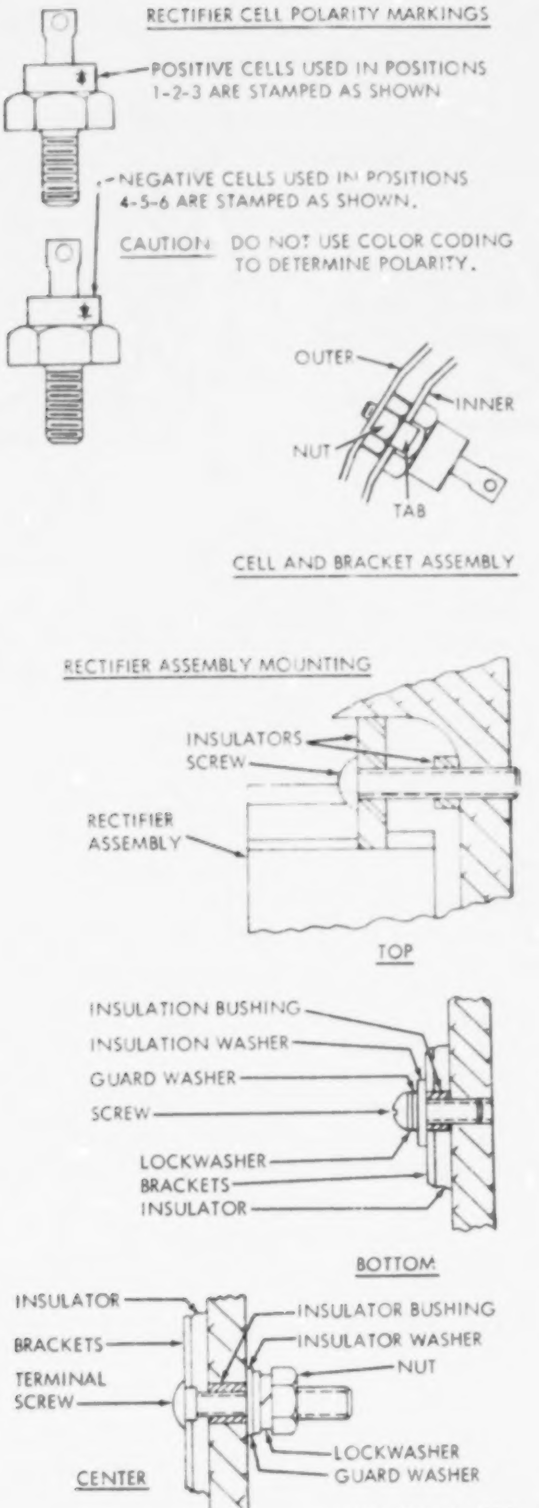
a. Reassemble the alternator in reverse of numerical sequence as illustrated on figure 3-3. Refer to figure 3-4 for correct rectifier cell mounting.

b. After reassembly, spin the alternator fan assembly (3) by hand to check for binding.

c. Check for a complete circuit from the rotor coil (37) through the slip rings (41) to the brush terminals (11).

3-11. Installation

Refer to TM 5-3805-204-12 and install the alternator.


RECTIFIER CELL POLARITY MARKINGS
POSITIVE CELLS USED IN POSITIONS 1-2-3 ARE STAMPED AS SHOWN
NEGATIVE CELLS USED IN POSITIONS 4-5-6 ARE STAMPED AS SHOWN.
CAUTION: DO NOT USE COLOR CODING TO DETERMINE POLARITY.
OUTER
INNER
NUT
TAB
CELL AND BRACKET ASSEMBLY
RECTIFIER ASSEMBLY MOUNTING
INSULATORS
SCREW
RECTIFIER ASSEMBLY
TOP
INSULATION BUSHING
INSULATION WASHER
GUARD WASHER
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LOCKWASHER
BRACKETS
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BOTTOM
INSULATOR
BRACKETS
TERMINAL SCREW
CENTER
INSULATOR BUSHING
INSULATOR WASHER
NUT
LOCKWASHER
GUARD WASHER

MEC 3805-240-35/3-4

Figure 3-4. Alternator rectifier cell details.

Section III. ALTERNATOR REGULATOR AND REVERSE POLARITY RELAY ASSEMBLY

3-12. General

a. The alternator regulator has two elements, a voltage regulator and a load relay. The voltage regulator element controls the line voltage by means of a double set of vibrating contacts. The load relay element is controlled by the ignition switch and completes the alternator field circuit in order to energize the field coil. It also connects the D.C. load to the A.C.-D.C. system.

b. The reverse polarity relay is a single element unit designed to protect the alternator rectifier cells from damage in case the battery cables or other wires to the alternator are accidentally reversed.

3-13. Testing

Refer to TM 5-3806-240-12 and test the alternator regulator and reverse polarity relay.

3-14. Removal

Refer to TM 5-3805-240-12 and remove the alternator regulator and the reverse polarity relay assembly.

3-15. Disassembly and Cleaning

a. Disassemble the regulator and relay in the numerical sequence as illustrated on figure 3-5.

b. Remove loose dirt and dust with clean, dry compressed air.

c. Clean the contacts with aluminum oxide cloth (180 grit or finer) or a contact burnishing tool. A final smooth contact surface is obtained by drawing a piece of hard, smooth surfaced bond paper over the contacts several times. If contacts cannot be cleaned satisfactorily by this method, replace the contacts.

3-16. Inspection and Repair

a. Refer to TM 5-3805-240-12 and inspect the regulator and relay for proper gap settings and worn or broken parts.

b. Replace regulator contacts when necessary by following these steps:

(1) Remove the springs from the hinge end of the armatures, and remove the armatures. (Unsolder the series winding lead from the spring bracket of the load relay).

(2) Remove the carrier block locking screws and carrier blocks.

(3) Remove the contact carriers and contact plates from the contact blocks. (Unsolder heavy jumper from the contact plate or the load relay element).

(4) Secure the new contact carriers, contact plates and all leads previously disconnected to the contact carrier blocks.

(5) Mount the carrier block on the yokes. Do not tighten the locking screw or solder the heavy jumper to the load relay contact plate until the gap settings have been made.

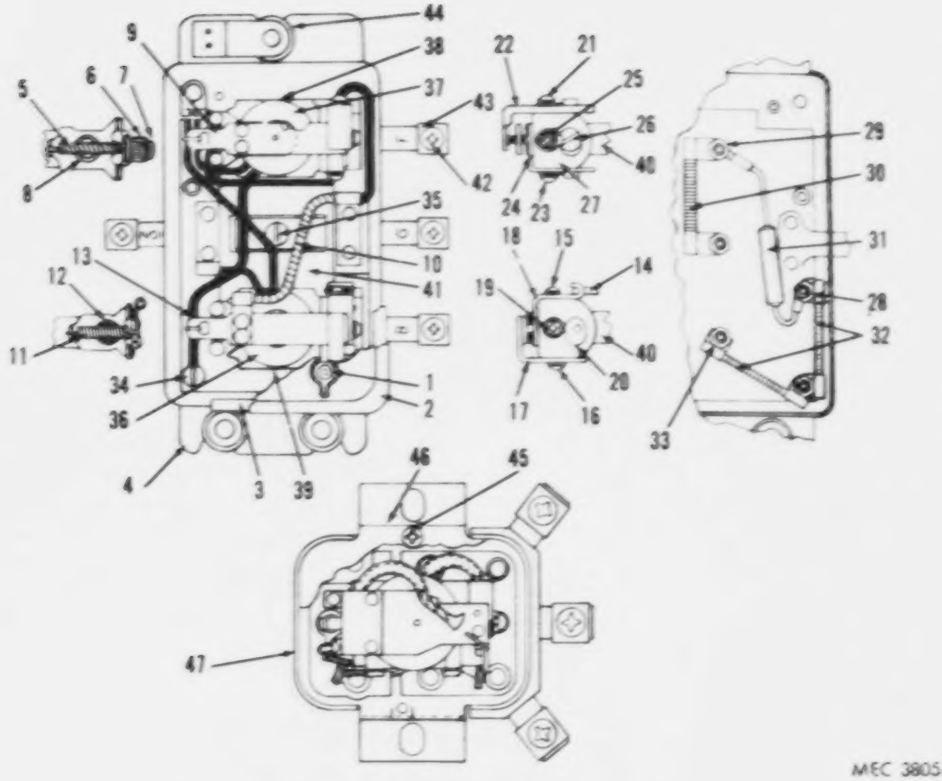
(6) Secure the armatures to the element yokes and resolder the series winding lead to the armature spring bracket of the load relay.

3-17. Reassembly

Reassemble the alternator regulator and reverse polarity relay in reverse of numerical sequence as illustrated on figure 3-5.

3-18. Installation

Refer to TM 5-3805-240-12 and install the alternator regulator and reverse polarity relay assembly.



MEC 3805-240-35/3-5

1	Wing nut (2 rqr)
2	Cover
3	Gasket
4	Base assembly
5	Spring
6	Nut
7	Screw
8	Screw
9	Armature assembly
10	Wire lead
11	Spring
12	Screw
13	Armature assembly
14	Jumper
15	Screw
16	Screw
17	Armature stop
18	Carrier assembly
19	Screw
20	Carrier block
21	Screw
22	Carrier assembly (upper)
23	Screw
24	Carrier assembly (lower)
25	Screw
26	Screw
27	Carrier block
28	Hex nut (5 rqr)
29	Guard washer (3 rqr)
30	Resistor (75 ohm)
31	Resistor (1500 ohm)
32	Resistor (20 ohm) (2 rqr)
33	Hex nut (5 rqr)
34	Screw
35	Screw
36	Coil assembly
37	Coil assembly
38	V. R. element assembly
39	Relay element assembly
40	Yoke (2 rqr)
41	Spacer plate
42	Screw (4 rqr)
43	Special washer (4 rqr)
44	Grommet assembly (3 rqr)
45	Cover screw (2 rqr)
46	Relay cover
47	Reverse polarity relay

Figure 3-5. Alternator regulator and reverse polarity relay assembly, cut-away view.

Section IV. STARTING MOTOR ASSEMBLY

3-19. General

The starting motor is a 24 volt D.C. series-wound motor with an integral solenoid switch and housing. The motor armature shaft powers the sprag clutch and pinion to crank the engine.

3-20. Removal

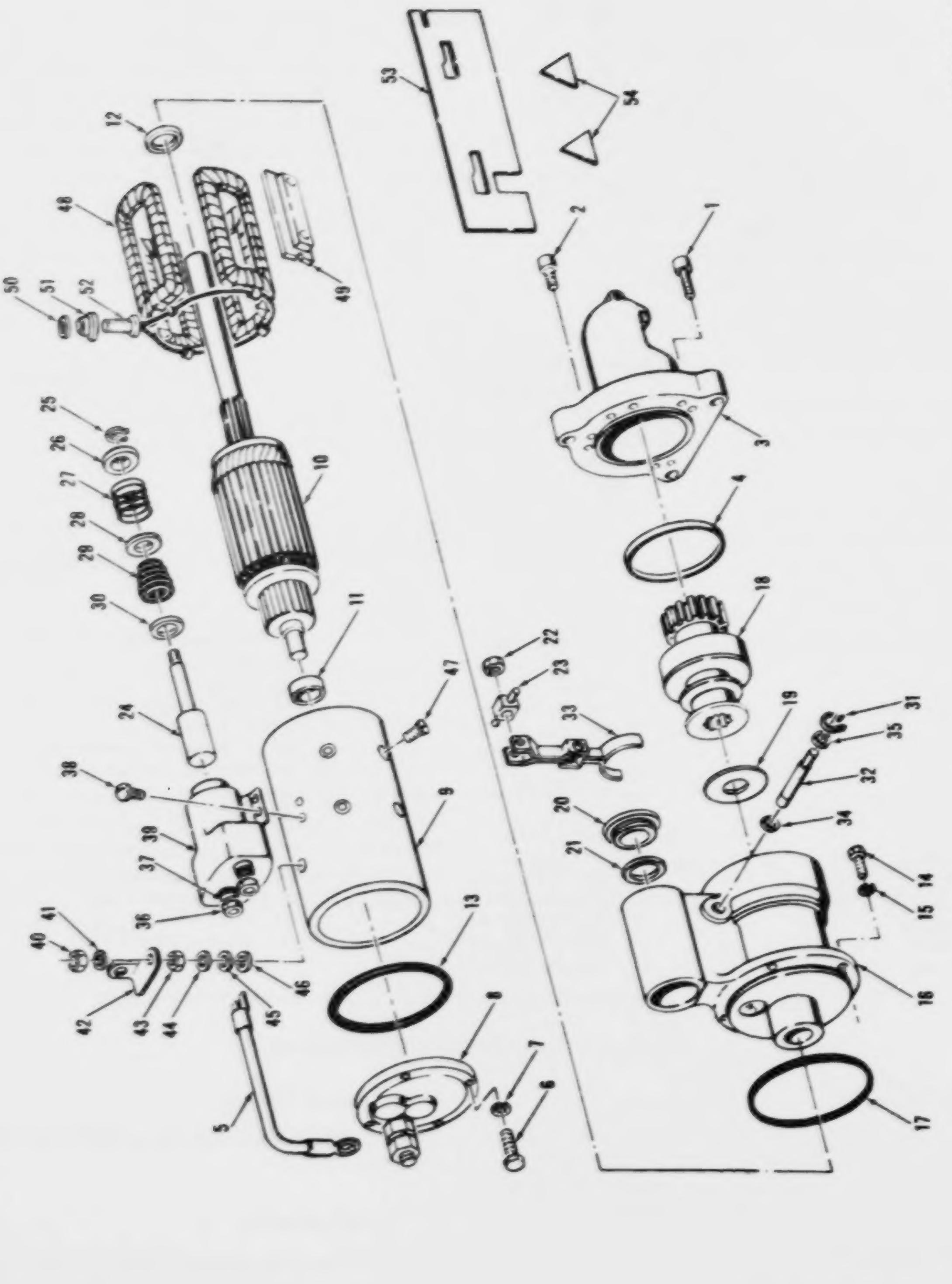
Refer to TM 5-3805-240-12 and test the starting motor.

3-21. Bench Testing

Refer to TM 5-3805-240-12 and test the starting motor.

3-22. Disassembly

a. Disassemble starting motor in the numerical sequence as illustrated on figures 3-6, 3-7, 3-8 and 3-9.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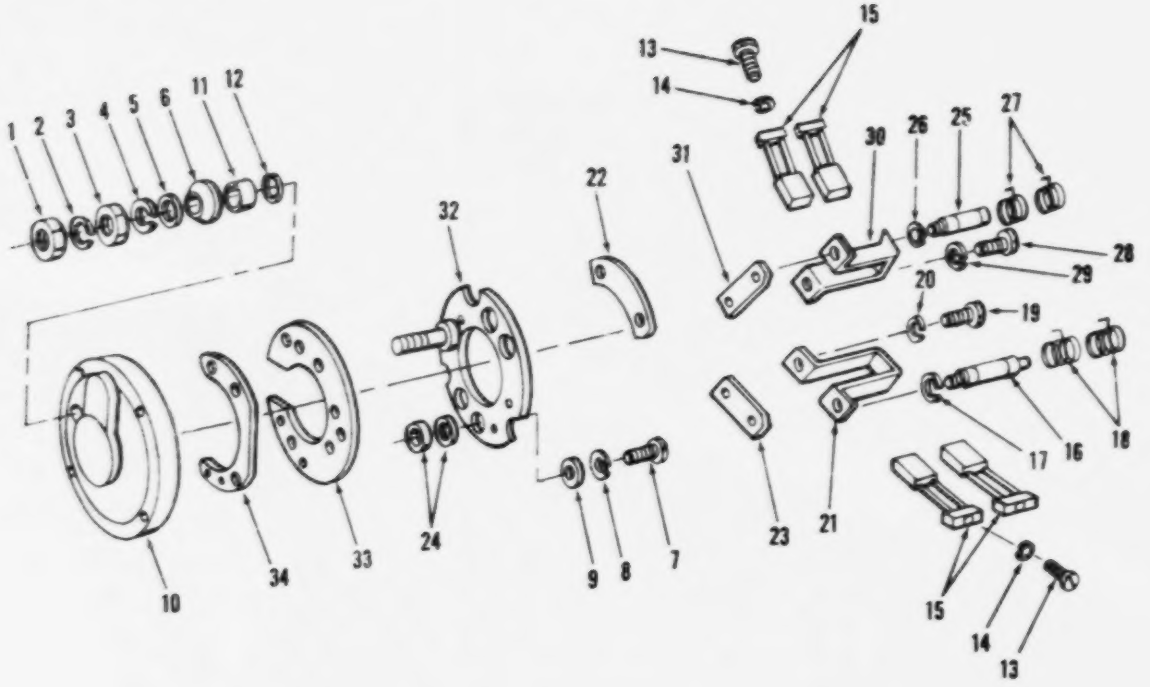
MEC 3805-240-35/3-6

Figure 3-6. Starter motor assembly, exploded view.

1	Screw (5 rqr)
2	Screw
3	Housing, drive
4	Gasket
5	Lead
6	Screw
7	Washer, lock (4 rqr)
8	Commutator end frame and brush plate assembly
9	Field frame assembly
10	Armature
11	Washer, thrust
12	Washer, spacer
13	Packing, preformed
14	Screw (5 rqr)
15	Washer, lock (5 rqr)
16	Housing, lever
17	Packing, preformed
18	Clutch assembly
19	Washer
20	Plug
21	Gasket
22	Nut
23	Guide
24	Plunger assembly
25	Ring, retaining
26	Retainer
27	Spring
28	Retainer
29	Boot
30	Washer
31	Ring, retaining
32	Shaft, lever
33	Shift lever
34	Packing, preformed
35	Packing, preformed
36	Nut (2 rqr)
37	Washer (2 rqr)
38	Screw and lockwasher (4 rqr)
39	Solenoid switch
40	Nut
41	Washer, lock
42	Connector
43	Nut
44	Washer
45	Washer
46	Washer
47	Screw, pole shoe (8 rqr)
48	Field coil
49	Shoe, pole (4 rqr)
50	Gasket
51	Bushing
52	Stud, terminal
53	Insulator, coil
54	Insulation (2 rqr)

Figure 3-6—Continued



MEC 3805-240-35/3-7

1	Nut	13	Screw (4 rqr)	25	Screw, special
2	Washer, lock (2 rqr)	14	Washer, lock (4 rqr)	26	Washer, lock (4 rqr)
3	Nut	15	Brush, electrical (4 rqr)	27	Spring, brush (4 rqr)
4	Washer, lock (2 rqr)	16	Screw, special	28	Screw
5	Washer, plain	17	Washer, lock (4 rqr)	29	Washer, lock (4 rqr)
6	Insulator	18	Spring, brush (4 rqr)	30	Holder, Brush (2 rqr)
7	Screw	19	Screw	31	Plate, brush
8	Washer, lock (4 rqr)	20	Washer, lock (4 rqr)	32	Plate
9	Washer, plain (4 rqr)	21	Holder, brush (2 rqr)	33	Insulator, plate
10	Frame	22	Plate	34	Plate
11	Bushing	23	Plate, brush		
12	Packing, preformed	24	Bushing washer, nonmetallic (4 rqr)		

Figure 3-7. Brush plate assembly, exploded view.

b. Disassemble the starting motor only so far as is necessary to repair or replace defective parts.

3-23. Cleaning

a. Clean all metal nonelectrical parts in an approved cleaning solvent and dry with compressed air.

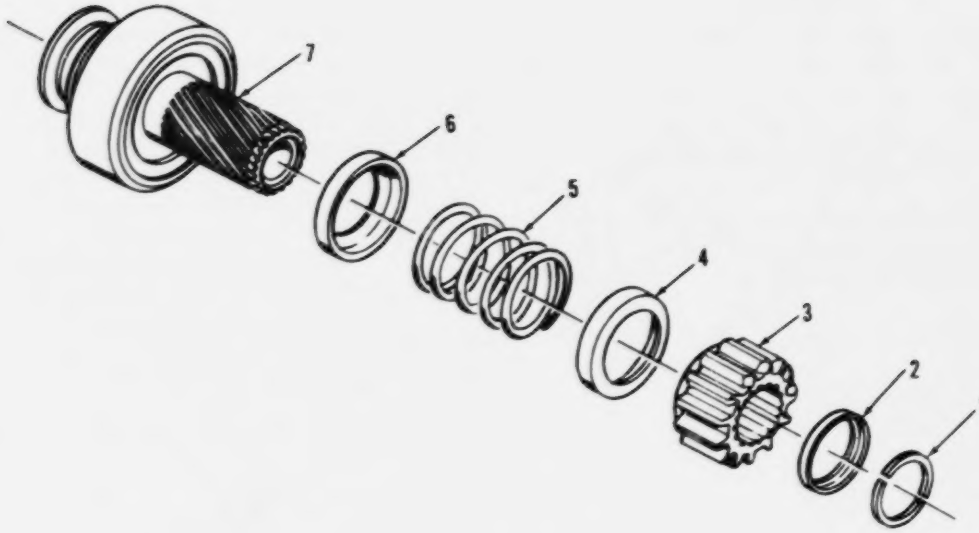
b. Clean field coils thoroughly with oleum spirits and a brush. Be careful not to damage protective insulation coating. Dry thoroughly with compressed air.

c. Remove loose particles from armature with compressed air and wipe with a clean cloth dampened in oleum spirits. Clean commutator lightly with No. 00 sandpaper and remove all traces of dust with low-pressure compressed air.

***Caution:* Do not use emery cloth to clean commutator.**

d. Clean solenoid relay, insulation plates, and nonmetallic washers with a clean cloth dampened with an approved cleaning solvent and dry with compressed air.

e. Clean brushes and clutch assembly with a dry clean cloth only. Do not permit solvent to contact brushes or clutch assembly.



MEC 3805-240-35/3-8

1 Washer, split	4 Cup, spring	7 Clutch assembly
2 Cup, pinion stop	5 Spring, meshing	
3 Pinion	6 Cup, spring	

Figure 3-8. Starting motor clutch assembly, exploded view.

3-24. Inspection and Repair

a. Inspect housings and frames for cracks and distortion. Inspect threads in tapped holes for damage. Replace defective parts.

b. Inspect sleeve bearings for wear, gouges, and grooves. Check for looseness in housing or commutator end frame. Replace worn or defective bearings. If new bearing is loose in bore, replace housing or commutator end frame.

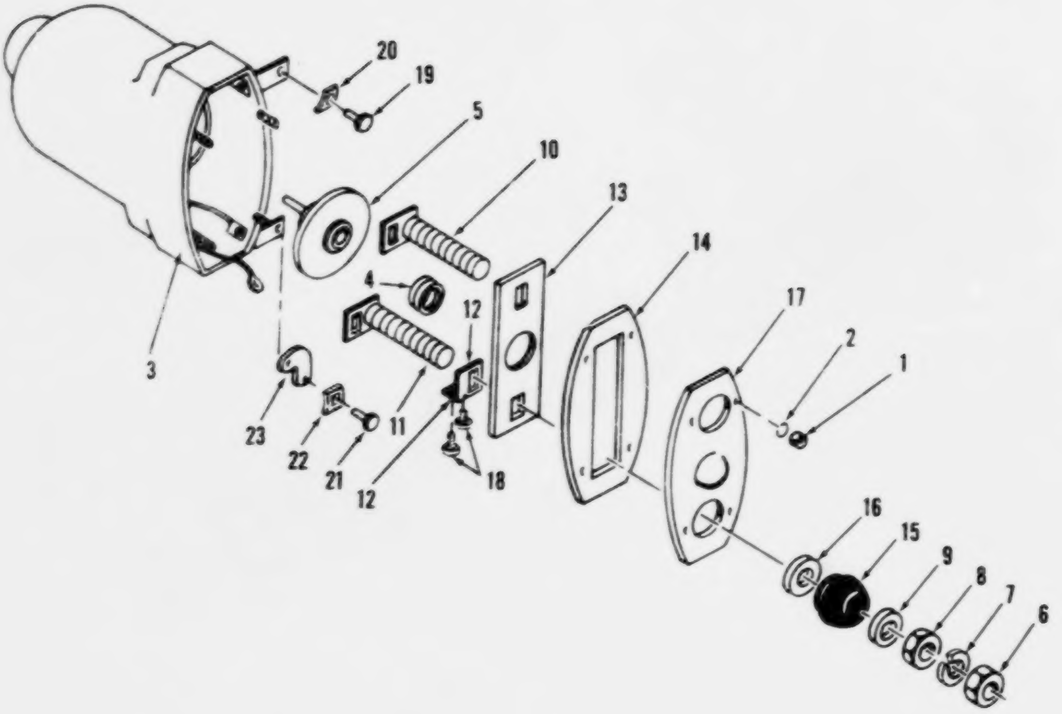
c. Inspect wicks for fraying or wear. Replace wick if defective.

d. Inspect armature for open circuits. Inspect the points where the conductors are joined to the commutator bars for loose connections. Poor connections cause arcing and burning of the commutator bars as the cranking motor is used. If the bars are not too badly burned, repair can often be effected by resoldering or welding the leads in the riser bars (using rosin flux), and turning down the commutator in a lathe to remove the burned material. The insulation should then be undercut. Replace an armature that cannot be repaired.

e. Inspect armature for grounds with a test light by touching one probe to armature core and other to commutator risers. If test light glows, the armature is grounded and must be replaced.

f. Inspect armature for short circuits using a growler fixture and a steel strip. Strip will vibrate against armature over a shorted area as the armature is turned. Shorts between bars are sometimes produced by brush dust or copper between the bars. These shorts can be eliminated by cleaning out the slots. Replace an armature that cannot be repaired.

g. Turn down commutator if grooved, burned, or out of round. Undercut mica to a depth of 0.025 to 0.032 inch below surface of commutator. Do not widen slots when undercutting mica.



1 Nut, hex (4 rqr)
2 Washer, lock (4 rqr)
3 Case and coil assembly
4 Spring
5 Contact assembly
6 Nut (2 rqr)
7 Washer, lock (2 rqr)
8 Nut (2 rqr)
9 Washer, plain (2 rqr)
10 Stud, terminal
11 Stud, terminal
12 Support terminal (2 rqr)
13 Strip, insulation
14 Gasket, plate
15 Bushing (2 rqr)
16 Insulator (2 rqr)
17 Plate, terminal
18 Screw (4 rqr)
19 Screw, terminal
20 Clip, terminal
21 Screw, terminal
22 Clip, terminal
23 Connector, ground

Figure 3-9. Solenoid switch assembly, exploded view.

h. Check field coils in the field frame for grounded circuits with a test lamp. Connect one lead of a 110-volt test lamp to the field frame and the other lead to the field connector. If the lamp lights, at least one field coil is grounded and must be repaired or replaced.

i. Check field coils in the field frame for open circuits with a test lamp. Connect test lamp leads to ends of field coils. If lamp does not light, the field coils are open. Repair or replace an open field coil.

j. Inspect drive pinion for broken or badly worn teeth. Inspect clutch splines for wear and damage. Inspect shell for cracked or broken condition. Check to make sure pinion will drive in one direction and will slip in opposite direction. Replace drive clutch if defective.

k. Inspect shift lever, shaft, and solenoid plunger for cracks or distortion. Replace defective parts.

l. Inspect solenoid relay windings for shorts or grounds with a pair of test probes. Inspect case for cracks or other damage. Replace solenoid relay if coil is defective.

3-25. Reassembly and Adjustment

a. Reassemble the starting motor in reverse of numerical sequence as illustrated on figures 3-6, 3-7, 3-8 and 3-9.

b. Coat threads of pole shoe screws (47, fig. 3-6) with a suitable thread sealer before installation.

c. Varnish inside of frame (9) and winding assembly (48). Leave 0.38 inch from each end of frame free of varnish.

d. Use a pole shoe spreader and pole shoe screwdriver to install pole shoes (49) and field coils (48) to prevent distortion of the field frame.

e. Where the pole shoe has a long lip on one side and a short lip on the other, the long lip should be assembled in the direction of armature rotation so it becomes the trailing (not leading) edge of the pole shoe.

f. Refer to figures 3-10 and 3-11 and check for proper pinion clearance as follows:

(1) Disconnect the motor field coil connector from the solenoid motor terminal.

(2) Connect battery to the solenoid switch terminal and to the solenoid frame or ground terminal (fig. 3-10).

(3) Momentarily flash a jumper lead from the solenoid motor terminal to the solenoid frame or ground terminal. The pinion will now shift into cranking position and remain so until the battery is disconnected.

(4) Push the pinion back towards the commutator end to eliminate slack movement.

(5) Measure the distance between pinion and pinion stop (fig. 3-11).

(6) Adjust clearance by removing plug and turn shaft nut.

(7) Adjust hex self-locking nut (22, fig. 3-6) until clearance between outer face of pinion and inner face of housing is 23/64 inch ± 1/32 inch.

3-26. Installation

Refer to TM 5-3805-230-12 and install the starting motor assembly.

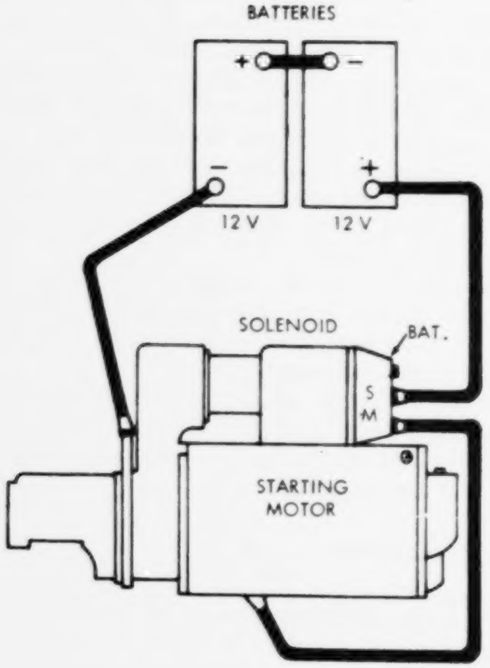


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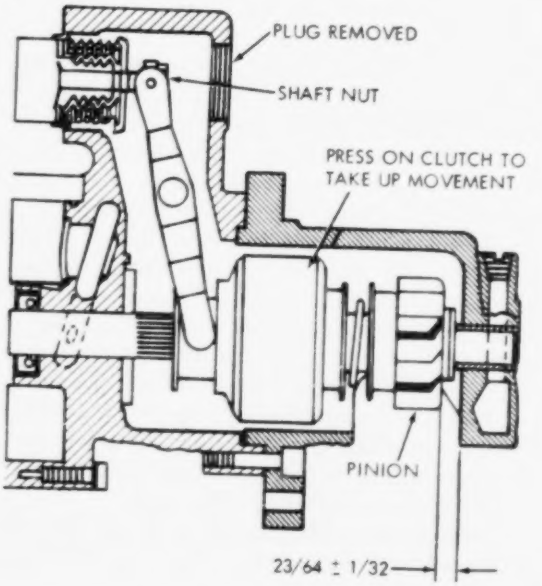
Figure 3-10. Circuit for Checking Pinion Clearance.



MEC 3805-240-35/3-11

Figure 3-11. Checking Pinion Clearance.

Section V. GOVERNOR ASSEMBLY

3-27. General

The variable speed governor is mounted on the front of the engine blower housing. The governor weight shaft is driven by the left hand blower rotor. The governor controls the engine idle speed, limits the maximum no-load speed, and holds the engine at any constant speed between idle and maximum, chosen by the operator.

3-28. Testing (on vehicle)

Refer to TM 5-3805-240-12 and test governor.

3-29. Removal

a. Disconnect throttle control rod from governor speed control lever (49, fig. 3-12). Disconnect booster spring (1, fig. 3-12) from speed control lever.

b. Disconnect return spring (29, fig. 3-12) from governor control lever (28). Disconnect the engine shutoff flexible cable from the governor control lever.

c. Remove eight screws and lift cover (6), retracting spring clip and gasket from governor housing.

d. Remove the rocker arm covers (TM 5-3805-240-12). Disconnect links (11, fig. 3-13) from control link operating lever (106, fig. 3-12) and injector control tube levers (13, fig. 3-13).

(1) Remove the right bank fuel rod by removing the screwtype pin (8, fig. 3-12), in the control link operating lever (106) and the clevis pin at the control tube lever and withdraw the fuel rod across cylinder head while rotating rod.

(2) Remove the left bank fuel rod by removing the governor operating lever link connecting pin (12) from the control link operating lever (106) after removing the spring retainer that holds the governor operating shaft lever (92) to the differential lever (11), then lift upwards, on connecting link (15). Remove the clevis pin at the control tube lever and withdraw fuel rod across cylinder head while rotating rod.

e. Remove the control link operating lever retaining ring from the governor operating lever link connecting pin (12) and remove the governor operating lever connecting link (15).

f. Loosen the hose clamps (16) on the fuel rod covers and slide each hose (17) and clamp toward governor.

g. Loosen hose clamps on water bypass tube. Slide hoses and clamps onto bypass tube and remove tube from engine.

h. Disconnect and remove the fuel lines from the fuel pump to the fuel strainer and filter.

i. Remove ten bolts (fig. 3-14) retaining the governor and fuel pump assembly to the blower. Slide the governor and fuel pump straight forward, from the blower dowels. Remove governor-to-blower gasket (25, fig. 3-12).

Note. **The fuel pump drive fork (4, fig. 3-15) may stay with either the fuel pump or the blower rotor shafts. Remove the fork.**

j. Remove three bolts and disassemble the fuel pump (1, fig. 3-15) and gasket from the governor assembly.

3-30. Disassembly

a. Disassemble the governor in the numerical sequence as illustrated on figure 3-12 and 3-13.

b. At this stage of disassembly, wash cover assembly thoroughly in clean fuel oil and inspect needle bearings for wear or damage. If bearings are satisfactory for further use, removal is unnecessary.

3-31. Cleaning

Wash all parts in clean fuel oil and dry with compressed air.

3-32. Inspection and Repair

a. Revolve operating shaft bearings and governor weight shaft bearings and governor weight shaft bearing slowly by hand; replace bearings if rough or if tight spots are detected.

b. Examine riser thrust bearing for excessive wear, flat spots or corrosion. If any of these conditions exist, replace the thrust bearing.

c. Inspect roller bearings and control lever shaft for excessive wear or flat spots. If one or both conditions exist, replace both the bearings and the control shaft.

d. Inspect spring lever shaft and bearings for excessive wear or flat spots at bearing surface. If one or both conditions exist, replace both the shaft and the bearings.

e. Examine weight shafts and weight bearings for excessive wear and flat spots. If either of these conditions exist, replace both the weight shaft and the bearings.

3-33. Reassembly

a. Reassemble the governor in reverse of numerical sequence as illustrated on figures 3-12 and 3-13.

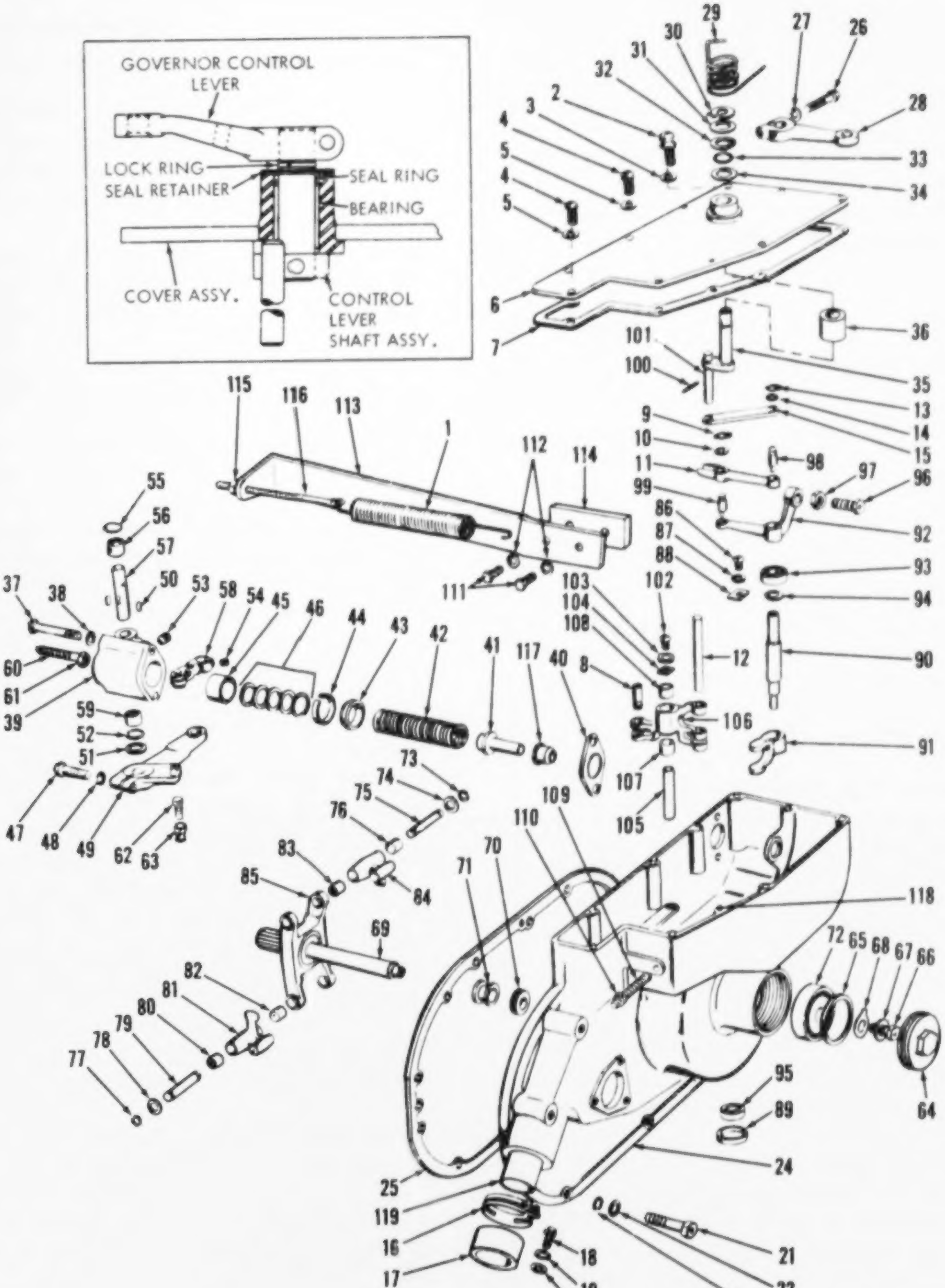
b. With lever (58, fig. 3-12) centered between bearing bosses, tighten set screw (54) to 12-15 ft-lbs torque and stake lever to lock the screw.

c. Apply sealant around edge at expansion plug into shaft opening.

3-34. Installation

a. Refer to paragraph 329 and install the governor.

b. Refer to TM 5-3805-240-12 and test and adjust governor on vehicle.


GOVERNOR CONTROL LEVER
LOCK RING
SEAL RETAINER
SEAL RING
BEARING
COVER ASSY.
CONTROL LEVER SHAFT ASSY.
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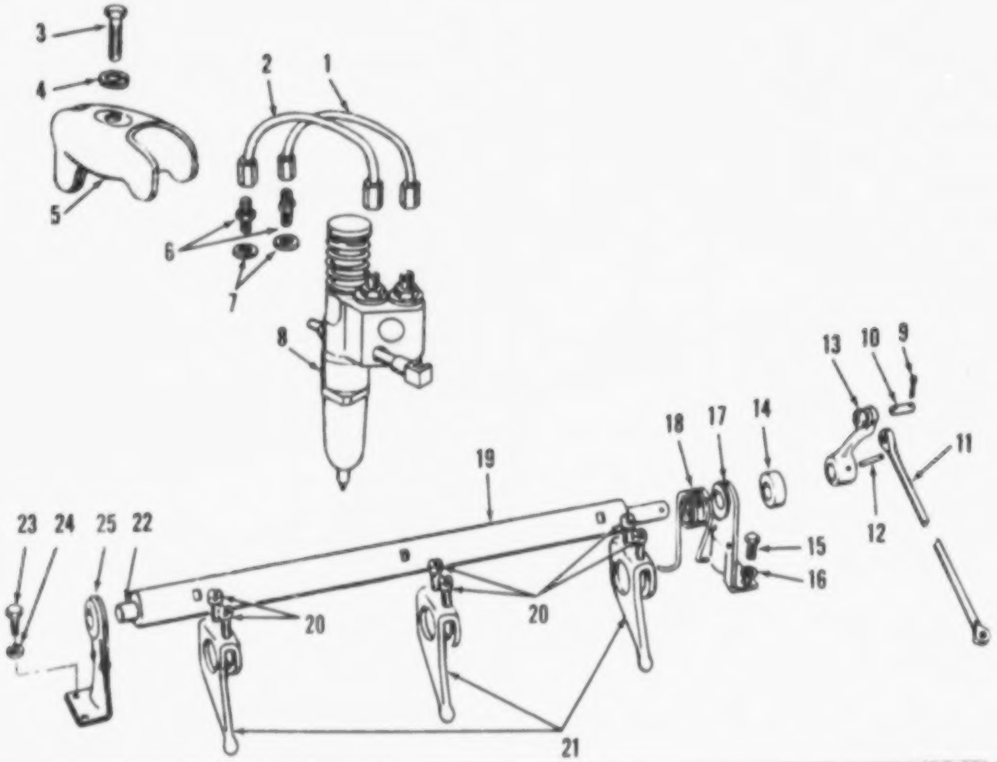
MEC 3805-240-35/3-12

Figure 3-12. Governor, exploded view.

1 Booster spring
2 Bolt, spring anchor
3 Lockwasher (8 rqr)
4 Bolt (drilled fil hd.) (6 rqr)
5 Lockwasher (8 rqr)
6 Cover assembly
7 Gasket
8 Pin
9 Retainer (2 rqr)
10 Washer (2 rqr)
11 Lever assembly, differential
12 Pin, connecting
13 Retainer (2 rqr)
14 Washer
15 Link, connecting
16 Clamp, hose (2 rqr)
17 Hose (2 rqr)
18 Bolt, 1/4-20 x 3/4 in. (2 rqr)
19 Lockwasher (2 rqr)
20 Washer, flat (2 rqr)
21 Bolt (fig. 3-14)
22 Lockwasher (10 rqr)
23 Washer, copper (2 rqr)
24 Housing assembly
25 Gasket
26 Bolt
27 Lockwasher (8 rqr)
28 Lever, governor control
29 Spring, lever return
30 Ring, retaining
31 Retainer, seal (2 rqr)
32 Retainer, seal (2 rqr)
33 Packing, preformed
34 Washer, back-up
35 Shaft assembly, control lever
36 Bearing
37 Bolt, 5/16-18 x 3-1/2 in. (2 rqr)
38 Lockwasher (10 rqr)
39 Housing, variable speed spring
40 Gasket
41 Plunger, variable speed spring
42 Spring, variable speed
43 Stop (with step)
44 Stop (with gap)
45 Retainer
46 Shim (.010) (as rqr) shim (.078) (as rqr)
47 Bolt, 1/4-20 x 7/8 in.
48 Lockwasher
49 Lever, speed control
50 Key, woodruff (2 rqr)
51 Washer
52 Packing, preformed
53 Plug, pipe
54 Set screw
55 Plug, expansion
56 Bearing
57 Shaft, speed control lever
58 Lever assembly, spring
59 Bearing
60 Adjusting screw, idle speed
61 Nut, hex
62 Bolt
63 Nut
64 Cap, governor weight housing
65 Gasket
66 Screw
67 Washer
68 Lockwasher
69 Shaft, governor weights
70 Bearing, thrust
71 Riser
72 Bearing
73 Retaining ring (2 rqr)
74 Washer, flat (2 rqr)
75 Shaft, weight (2 rqr)
76 Weight (2 rqr)
77 Retaining ring (2 rqr)
78 Washer, flat (2 rqr)
79 Shaft, weight (2 rqr)
80 Weight (2 rqr)
81 Bearing, needle
82 Bearing, needle
83 Bearing, needle
84 Bearing, needle
85 Carrier
86 Screw
87 Lockwasher
88 Washer, flat
89 Plug, expansion
90 Shaft, operating
91 Fork, operating
92 Lever, operating shaft
93 Bearing, upper
94 Washer
95 Bearing, lower
96 Adjusting screw
97 Nut
98 Pin
99 Pin
100 Pin, taper
101 Pin
102 Screw (2 rqr)
103 Washer
104 Clip
105 Pin, control link operating
106 Lever assembly control link operating
107 Bearing, needle
108 Bearing, needle
109 Buffer screw assembly
110 Nut, hex
111 Bolt, 3/8-16 x 1-1/4 in. (2 rqr)
112 Lockwasher (2 rqr)
113 Booster spring bracket
114 Spacer
115 Nut, adjusting eye lock
116 Adjusting eye
117 Guide, plunger
118 Pin, dowel (2 rqr)
119 Tube (2 rqr)

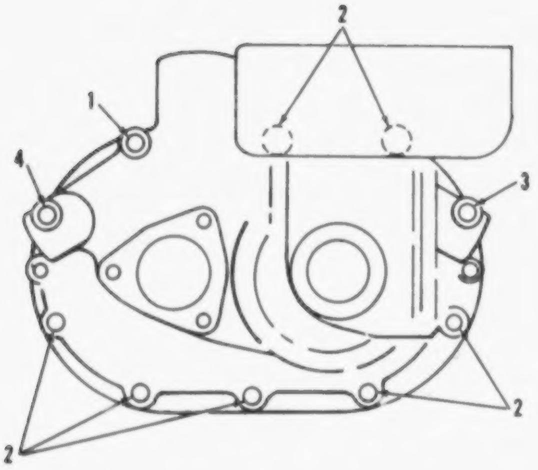
Figure 3-12—Continued



MEC 3805-240-35/3-13

1 Pipe assembly (short) (6 rqr)
2 Pipe assembly (long) (6 rqr)
3 Bolt, 3/8-16 x 2 in. (6 rqr)
4 Washer (6 rqr)
5 Clamp (6 rqr)
6 Connector (12 rqr)
7 Washer (12 rqr)
8 Injector assembly (6 rqr)
9 Cotter pin (4 rqr)
10 Pin (2 rqr)
11 Link, bank
12 Pin, groove (2 rqr)
13 Lever (2 rqr)
14 Spacer
15 Bolt, 1/4-20 x 5/8 in. (4 rqr)
16 Lockwasher (4 rqr)
17 Bracket (4 rqr)
18 Spring (2 rqr)
19 Tube assembly, right bank
19 Tube assembly, left bank
20 Screw (12 rqr)
21 Lever assembly (6 rqr)
22 Pin (2 rqr)
23 Bolt, 1/4-20 x 5/8 in. (4 rqr)
24 Lockwasher (4 rqr)
25 Bracket (2 rqr)
25 Bracket (4 rqr)

Figure 3-13. Injector control tube assembly and fuel manifold connections, exploded view.



ITEM	QTY.	BOLT SIZE	TYPE OF WASHER
1	1	5/16-18 NC x 3-3/4 IN. LG.	LOCK
2	7	5/16-18 NC x 2-1/4 IN. LG.	LOCK
3	1	5/16-18 NC x 5-1/4 IN. LG.	COPPER
4	1	5/16-18 NC x 4 IN. LG.	COPPER

MEC 3805-240-35/3-14

Figure 3-14. Governor Mounting Bolts and Washers.

Section VI. FUEL PUMP ASSEMBLY

3-35. General

The fuel pump transfers an excess supply of fuel from the supply tank to the fuel injectors, which purges air from the system and cools the injectors. The fuel pump is attached to the governor housing and is driven off the right hand blower rotor through a fork and disc assembly.

3-36. Testing (on vehicle)

Refer to TM 5-3805-240-12 and test the fuel pump.

3-37. Removal

a. Disconnect the fuel tubes from the inlet and outlet openings in the cover of the fuel pump.

b. Remove the three bolts and seal washers (1 and 2, fig. 3-15) and withdraw the fuel pump from the governor housing. Remove the drive coupling fork (4, fig. 3-15) from the blower drive coupling disc.

3-38. Disassembly

a. Disassemble the fuel pump in the numerical sequence as illustrated on figure 3-15.

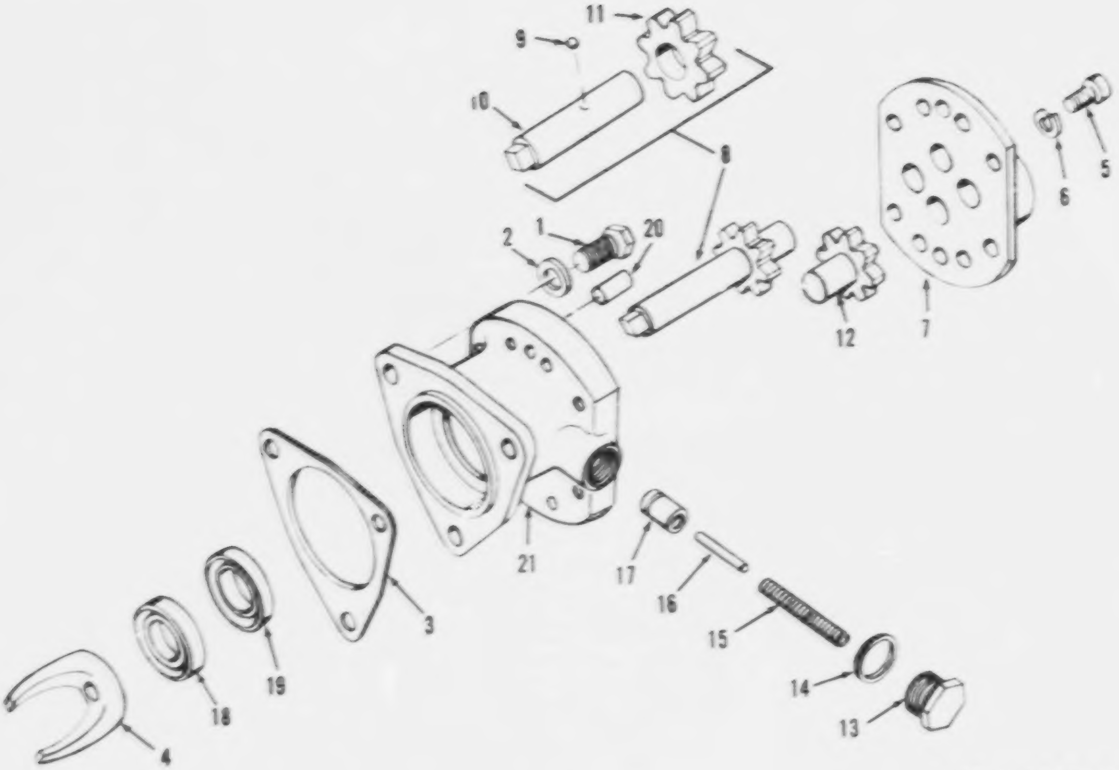
b. Press drive shaft just far enough to remove steel locking ball (9). Then, invert shaft and gear assembly in press and shaft (10) from gear (11). Do not misplace steel ball. Do not press squared end of shaft through gear as slight score marks will damage oil seal contact surface.

c. If oil seals (18, 19) need replacing, remove by clamping pump body in a bench vise and screwing threaded end of tool outer oil seal (seal nearest to bolting flange). Then tap pilot end of shaft with hammer to remove seal. Repeat this operation to remove inner oil seal.

Caution: **Note position of inner oil seal lip before removing. The new seal must be installed in the same position.**

3-39. Cleaning

Wash all parts in clean fuel oil and dry with compressed air.



MEC 3805-240-35/3-15

1	Bolt (3 rqr)
2	Seal washer (3 rqr)
3	Gasket
4	Fork, coupling
5	Bolt, lock (8 rqr)
6	Washer, lock (8 rqr)
7	Cover
8	Drive shaft assembly
9	Ball, steel
10	Shaft, drive
11	Gear, drive
12	Driven shaft assembly
13	Plug
14	Gasket
15	Spring
16	Pin
17	Valve
18	Oil seal
19	Oil seal
20	Pin, dowel (2 rqr)
21	Body, pump

Figure 3-15. Fuel pump, exploded view.

3-40. Inspection and Repair

a. Discard oil seals removed from the pump body and install new seals. The lips of oil seals must fit snug around the pump shaft and must be free of nicks or cracks.

b. Check pump gear teeth for scoring, chipping or wear. Check the ball slot in drive gear for wear. If necessary, replace with a new gear.

c. Inspect drive and driven shafts for scoring or wear. Replace with new shafts if necessary. The driven shaft is serviced as a gear and shaft assembly only.

d. The mating faces of the pump body and cover must be flat and smooth and fit tightly together. Any scratches or slight damage may result in pressure leaks. Also check for wear at areas of contact by gears and shafts. Replace with a new body or cover if necessary.

e. The relief valve must be free from score marks and burrs and fit its seat in the pump body. If the relief valve is scored and cannot be cleaned up with fine emery cloth or crocus cloth, replace the valve.

f. The valve spring has a free length of 1.97 inch and requires a load of 7.3 ± 2 pounds to compress it to a length of 1.18 inch when new. If the spring falls below the above specifications, install a new spring.

3-41. Reassembly

a. Reassemble the fuel pump in reverse of numerical sequence as illustrated on figure 3-15.

b. Observe the following procedures during reassembly:

(1) Lubricate the lips of oil seals (18 and 19, fig. 3-15) with a light coat of vegetable

shortening, then install oil seals in pump body (21) as follows:

(*a*) Place inner oil seal so that lip of seal will face in same direction as original seal which was removed.

(*b*) With pump supported on wood blocks (fig. 3-16) insert pilot of installer handle into pump body so seal starts straight into pump flange. Then, drive seal into place in counterbore of flange. until it bottoms.

(*c*) Place shorter end of adapter over pilot and against shoulder of installer handle (fig. 3-17). Place outer oil seal on pilot of installer handle with lip of seal facing adapter. Then, insert pilot of installer handle into pump so seal starts straight in pump flange and drive seal into pump body until shoulder of adapter contacts pump body. Thus the oil seals will be positioned so that the space between the seals will correspond with the drain holes located in the bottom of the pump body.

(2) Clamp pump body (21, fig. 3-15) in soft jaws of bench vise with relief valve cavity up. Lubricate the outside diameter of valve (17) and place valve in cavity with hollow end up.

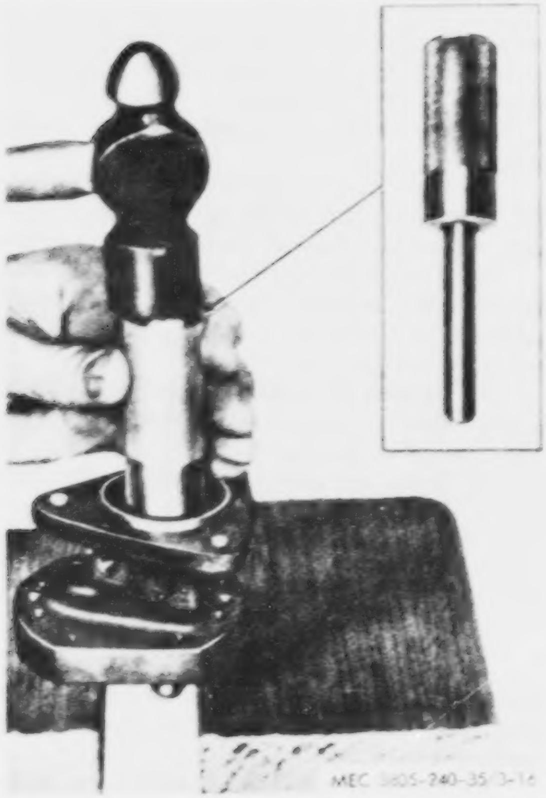

MEC 3805-240-35/3-16

Figure 3-16. Installing inner oil seal in pump body with installer handle & adapter.

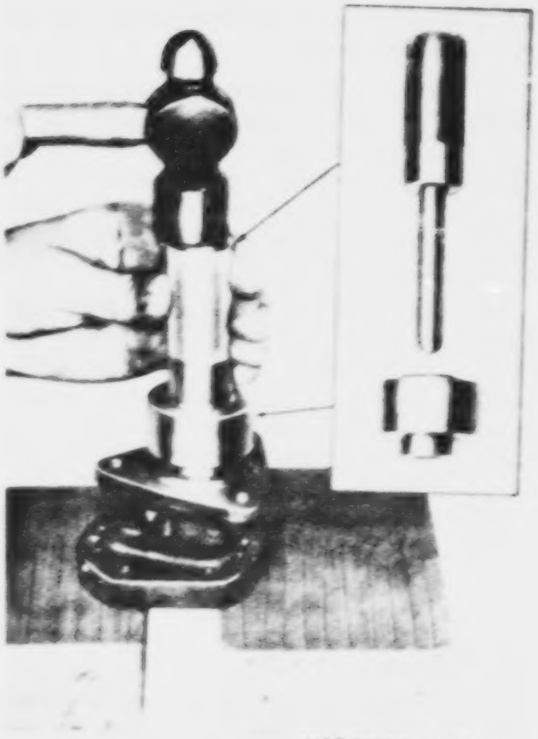

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Figure 3-17. Installing outer oil seal in pump body with installer handle & adapter.

Insert spring (15) inside of valve and pin (16) inside of spring. With new gasket (14) in place next to head of valve plug (13) place plug over spring and thread into pump body. Tighten plug.

(3) Install the fuel pump drive gear (11) over end of drive shaft (10) which is not squared (so slot in gear will face plain end of shaft when installed). This operation is very important, otherwise fine score marks caused by pressing gear into position from square end of shaft may cause rapid wear of the oil seals. Press gear beyond gear retaining ball detent. Then, place the ball (9) in detent and press gear back until end of slot contacts ball.

(4) Lubricate pump shaft and insert square end of drive shaft into opening at gear side of pump body and through the oil seals.

(5) Place driven shaft assembly (12) in pump body.

(6) Lubricate gears and shafts with clean engine oil.

(7) Apply a thin coating of sealer on face of pump cover (7) outside of gear pocket area, then place cover against pump body with two

dowel pins (20) in cover entering holes in pump body. The cover can be installed in only one position over the two shafts.

Caution: **The coating of sealant must be extremely thin since pump clearances are set up on the basis of metal-to-metal contact. Too much sealant increases the clearances and affect pump efficiency. Be sure no sealant enters the gear compartment to avoid possible damage to gears and shafts.**

(8) Secure cover (7) in place with eight bolts (5) and lockwashers (6), tightening bolts alternately and evenly.

(9) Rotate the pump drive shaft assembly (8) by hand to make certain the parts rotate freely. If necessary, tap the corner of the pump with a hammer.

(10) If pump is not to be installed immediately, use plastic shipping plugs in inlet and outlet openings to prevent dirt or other foreign material from entering pump.

3-42. Installation

a. Install the pump with the inlet opening in the pump cover (marked "L.H. IN") next to the balance weight cover.

b. Affix gasket (3, fig. 3-15) to the pump body; then, put the drive coupling fork (4) on the square end of the drive shaft (8).

c. Place the fuel pump up against the governor housing, being certain that the drive coupling fork registers with the slots in the drive disc.

d. Secure the pump to governor housing with three bolt and seal washer assemblies (1, 2).

e. If removed, install the fuel inlet and outlet elbows in the pump cover. Connect the inlet and outlet fuel lines to the fuel pump elbows.

Section VII. WATER PUMP ASSEMBLY

3-43. General

The water pump circulates the engine coolant through the cylinder block, cylinder heads, radiator and the engine oil cooler. The pump is mounted on the engine front cover and is driven by the front camshaft gear.

3-44. Removal

Refer to TM 5-3805-240-12 and remove the water pump.

3-45. Disassembly

a. Disassemble the water pump in the numerical sequence as illustrated on figure 3-18.

b. Turn the pump drive gear (20, fig. 3-18) so the slot in the gear is over the ends of the bearing lock ring (12), insert retaining ring pliers into the slot and with the aid of a small screwdriver remove the ring from the groove (fig. 3-30) in body (10, fig. 3-18).

c. Refer to figure 3-19 and remove the water seal.

Caution: **While holding the gear do not damage the gear teeth.**

3-46. Inspection and Repair

a. Inspect parts for cracks, other damage and wear. Replace damaged or worn parts.

b. Examine the bearings for corrosion, pitting, wear and freedom of movement. Apply engine oil to the bearings, hold the inner race and slowly revolve the outer race to check for roughness. Replace the bearings if necessary.

c. Inspect the ceramic impeller insert for cracks, scratches and bond to the impeller. To replace a damaged ceramic insert in the water pump impeller, proceed as follows:

(1) Remove he damaged ceramic impeller insert.

(2) Clean the insert area on the impeller with sandpaper, wire brush or a buffing wheel to remove the old adhesive, rust, scale and grease.

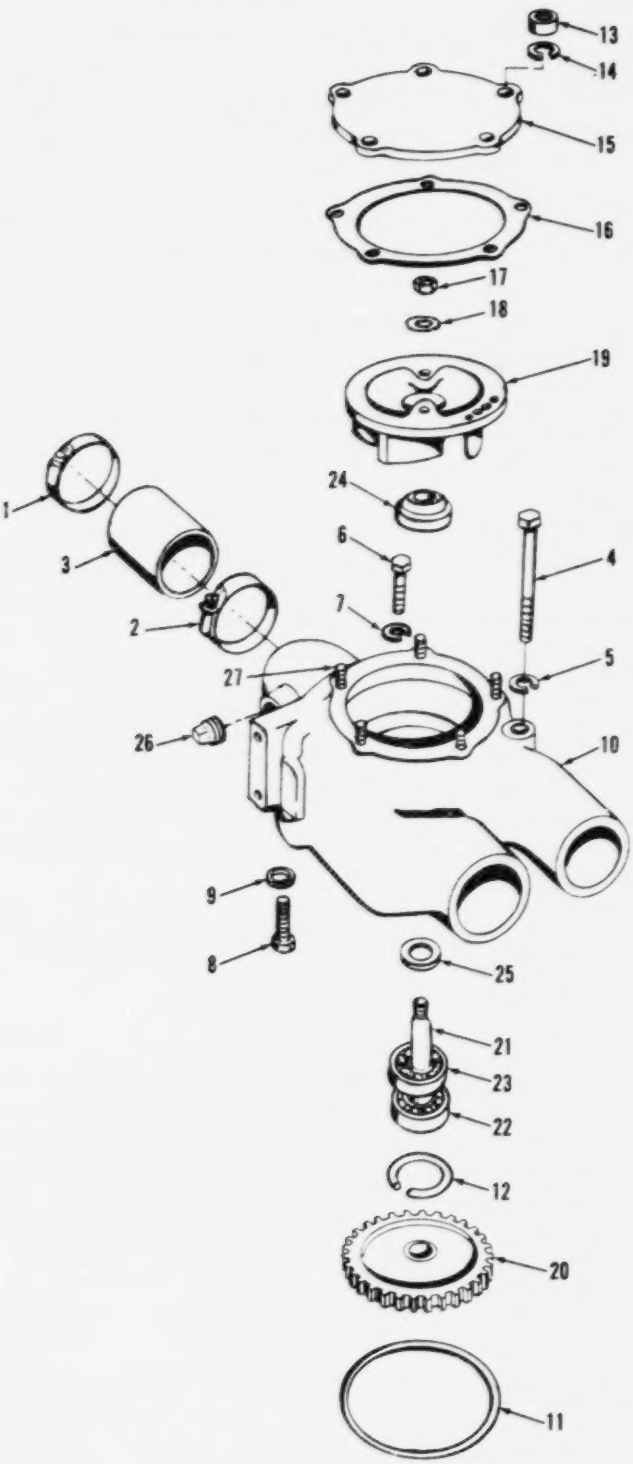
(3) Wet a clean cloth with a suitable solvent and wipe the impeller insert area until no discoloration is visible on the cloth. Then wipe the area with a clean, dry cloth.

(4) Squeeze the adhesive, provided with the impeller insert replacement kit, into a small container and stir thoroughly.

(5) Apply the adhesive evenly on the metal surface of the impeller, then place the ceramic insert with grooved surface against the impeller and press firmly with your fingers. The adhesive must squeeze out around the entire circumference of the inside and outside joints.

Caution: **The ceramic insert must be square with the axis of the tapered bore within 0.001 inch. Use the pump shaft as a mandrel for checking alinement.**

(6) Place the impeller assembly, ceramic seat up, in an oven preheated to 350° F (176.67° C) for one hour to cure the adhesive. The adhesive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MEC 3805-240-35/3-18

Figure 3-18. Water pump assembly, exploded view.

1 Clamp
2 Clamp
3 Hose
4 Bolt, 7/16-14 x 4-1/4 in.
5 Lockwasher, 7/16 in.
6 Bolt, 7/16-14 x 1-1/2 in.
7 Lockwasher, 7/16 in.
8 Bolt, 7/16-14 x 1-1/2 in.
9 Lockwasher, 7/16 in.
10 Body assembly (includes item 25)
11 Seal ring
12 Lock ring
13 Nut, 5/16 in. -24 hex (5 rqr)
14 Lockwasher, 5/16 in. (5 rqr)
15 Cover
16 Gasket
17 Lock nut
18 Flat washer, 7/16 in.
19 Impeller assembly
20 Gear, drive
21 Shaft
22 Bearing, outer
23 Bearing, inner
24 Seal assembly, water
25 Seal, oil
26 Plug, 1/2 in.
27 Stud (5 rqr)

Figure 3-18—Continued

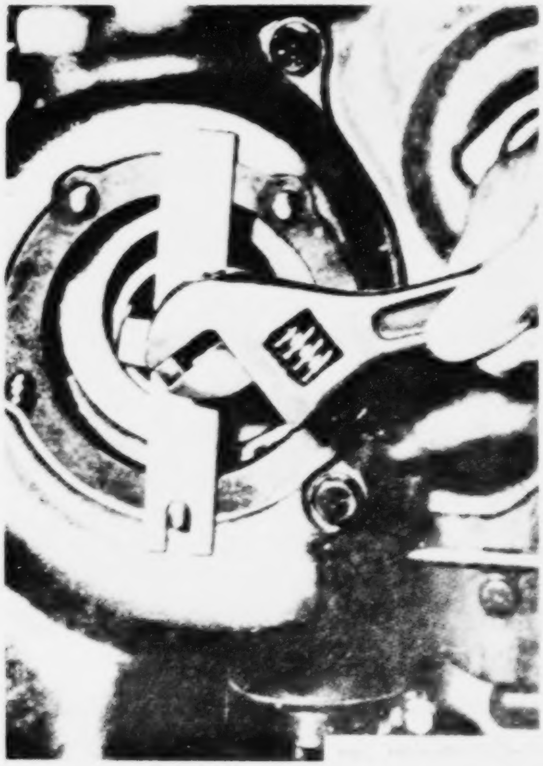


Figure 3-19. Removing Water seal from pump.

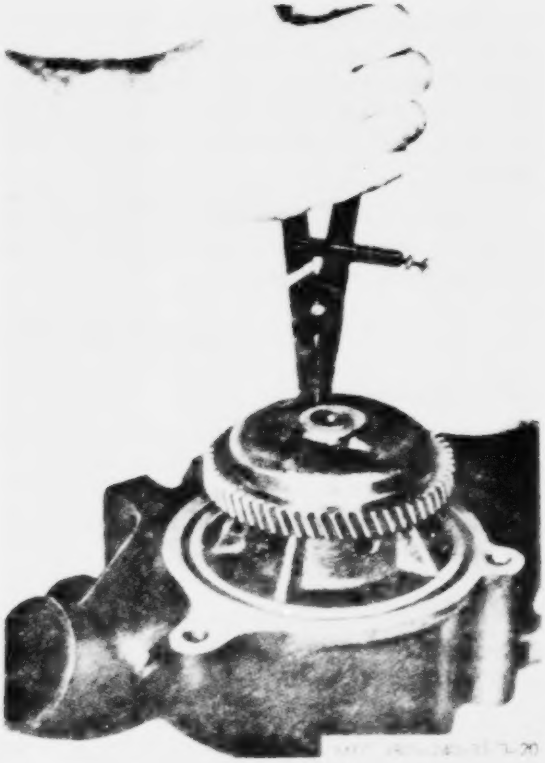


Figure 3-20. Removing bearing retaining ring.

will change color indicating the completion of the cure.

(7) Remove the impeller from the oven and after it has cooled to room temperature install it in the pump.

3-47. Reassembly

a. Reassemble the water pump in reverse of the numerical sequence as illustrated on figure 3-18.

b. Apply a film of engine oil to the circumference of a new oil seal (25, fig. 3-18) and place with the lip of the seal away from the tool.

c. Insert the seal into the pump body (10) and tap the seal into place.

d. Place the pump body (10) on the bed of an arbor press. Insert the water seal assembly (24) into the cavity in the pump housing and with a sleeve large enough to fit around the seal and rest on the brass cartridge lip, press the water seal assembly into place.

e. Lubricate the bearing bores and shaft bearing surfaces with a light film of engine oil. With shaft (21) supported on the bed of an arbor press, threaded end up, use an adapter and press bearing (23) into position. Reverse the assembly and press bearing (22) into position on the shaft.

Caution: **During assembly apply pressure only to the inner races of the bearings.**

f. Support the pump body (10) on the bed of an arbor press with the studs down. Lubricate the water seal contact surface of the shaft and insert it threaded end down into the pump body. Press the shaft and bearing assembly into place by applying pressure on the outer race of the large bearing (22).

Caution: **Support the pump body so the studs do not rest on the bed of the arbor press.**

g. Install the bearing lock ring (12).

h. Place the water pump with the impeller end of the shaft supported on the bed of an arbor press. Place the gear (20) between the shaft (21) and the ram of the press. Press the gear on the shaft so it is against the inner race of the bearing.

Caution: **Use a support so the pump body or studs cannot rest on the bed of the press while pressing on the gear.**

i. Make sure the mating surfaces of the water seal (24) and the creamic insert in impeller (19) are free of dirt, metal particles and oil film. Then, press the impeller on the shaft.

j. Place the washer (18) and locknut (17) on the shaft (21). Hold the pump gear (20) securely and tighten the nut (17) to 45-50 ft-lbs torque.

Caution: **Do not damage the gear teeth while holding the gear.**

k. Insert a feeler gage into the water outlet opening of the pump. The minimum clearance between the impeller and the pump body shall be 0.015 inch.

l. Use a new gasket (16) and install the water pump cover (15). Tighten the nuts (13) securely.

3-48. Installation

Refer to TM 5-3805-240-12 and install the water pump.

Section VIII. AIR INLET HOUSING ASSEMBLY

3-49. General

The air inlet housing is mounted on top of the blower. A valve inside of the housing may be closed to shut off the air supply and stop the engine when abnormal operating conditions require an emergency shut-down.

3-50. Removal

Refer to TM 5-3805-240-12 and remove the air inlet housing assembly.

3-51. Disassembly

Disassemble the air inlet housing in the numerical sequence as illustrated on figure 3-21.

Note. Observe the position of the air shut-down valve and the valve spring. They must be reassembled in the same position.

3-52. Cleaning

Clean all parts, including the blower screen, with clean fuel oil and dry with compressed air.

3-53. Inspection and Repair

a. Inspect all parts for wear and damage and replace as required. Use new seals to assure a tight seal between shaft and housing.

b. Inspect the face of the shutdown valve to be sure it is perfectly flat. If the valve is warped it will not seal tightly when in the shut position. Replace a warped or damaged shut down valve.

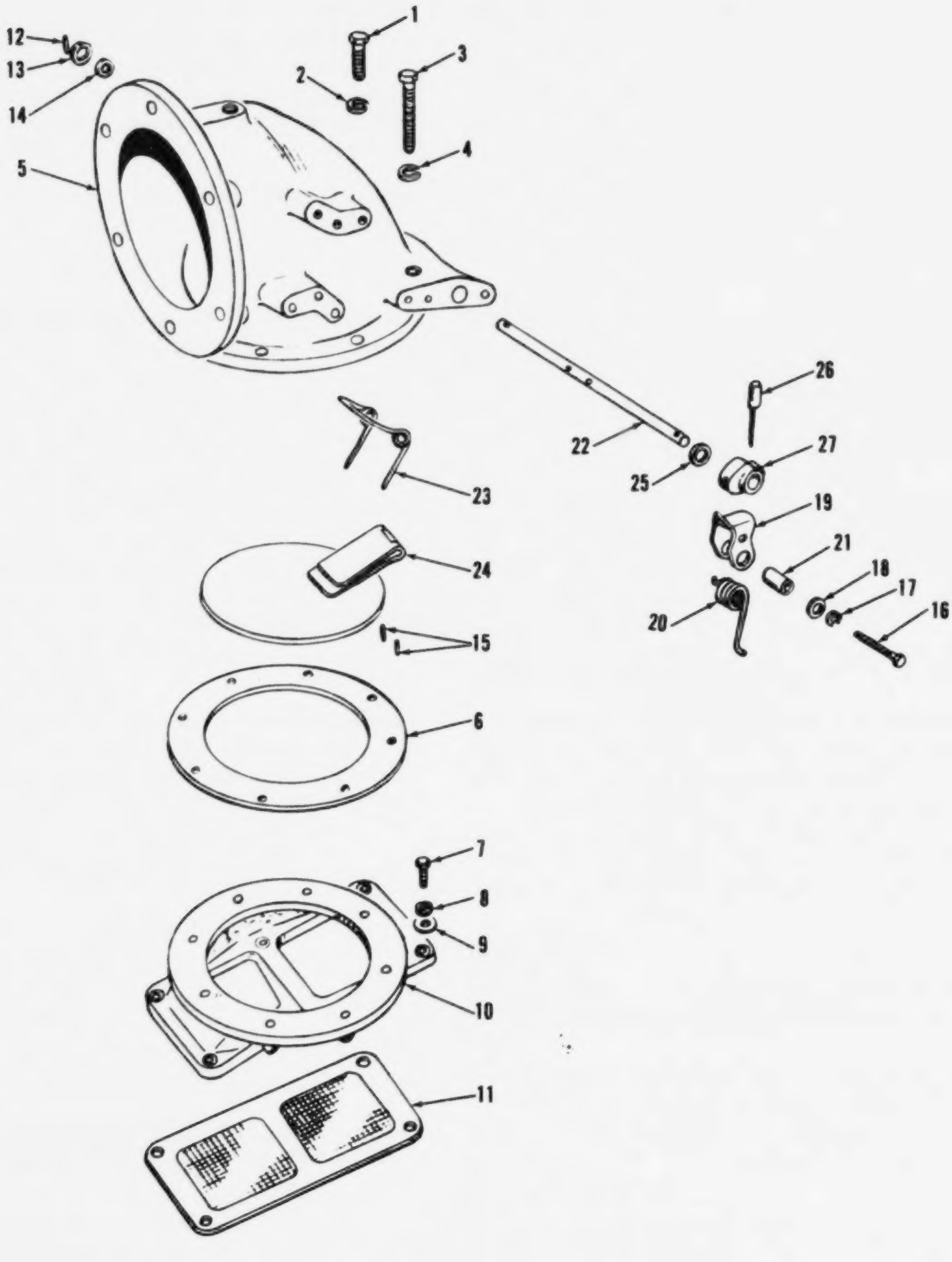
3-54. Reassembly

a. Reassemble the air inlet housing in reverse of the numerical sequence as illustrated on figure 3-21.

b. Position shut-down valve and valve spring in housing as shown on figure 3-22. Slide the shaft into the housing from the latch end while holding the shut-down valve in the position noted at disassembly.

3-55. Installation

Refer to TM 5-3805-240-12 and install the air inlet housing.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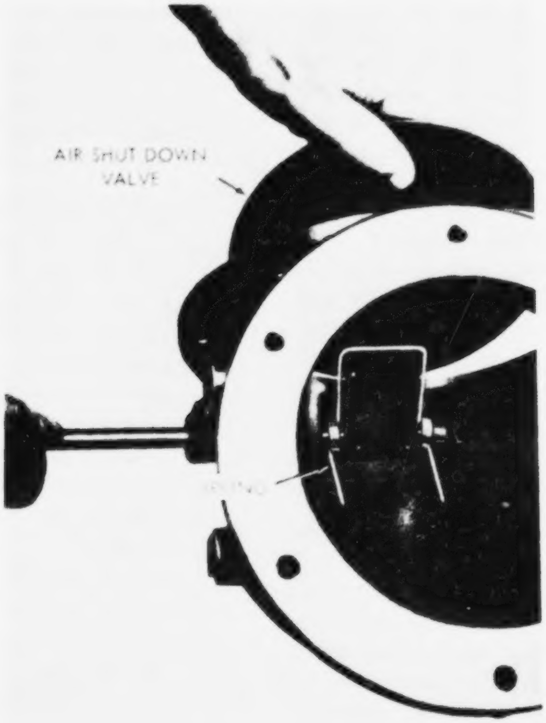
MEC 3805-240-35/3-21

Figure 3-21. Air inlet housing, exploded view.

1 **Bolt, 3/8-16 x 1-1/4 in. (4 rqr)**
2 **Lockwasher, 3/8 in. (4 rqr)**
3 **Bolt, 3/8-16 x 3-1/2 in. (2 rqr)**
4 **Lockwasher, 3/8 in. (2 rqr)**
5 **Housing**
6 **Gasket**
7 **Bolt, 3/8-16 x 1-1/8 in. (6 rqr)**
8 **Lockwasher, 3/8 in. (6 rqr)**
9 **Washer, flat 3/8 in. (6 rqr)**
10 Adapter
11 Screen
12 Pin, roll 1/8 x 11/16 in.
13 Washer, flat 3/8 in.
14 Seal (2 rqr)
15 Pin, 1/8 x 11/16 in. roll (2 rqr)
16 Bolt, 1/4-20 x 1-1/2 in.
17 Lockwasher, 1/4 in.
18 Washer, flat 1/4 in.
19 Latch
20 Spring, Latch
21 Spacer
22 Shaft, valve
23 Spring, valve
24 Valve, shut-down
25 Seal (2 rqr)
26 Handle assembly
27 Cam

Figure 3-21—Continued



MEC 3805-240-35/3-22

Figure 3-22. Installing air shut-down valve and spring.

Section IX. BLOWER ASSEMBLY

3-56. General

The blower supplies the fresh air needed for combustion and scavenging. Its operation is similar to that of a gear-type oil pump. Two hollow three-lobe rotors revolve with very close clearances in a housing bolted to the top deck of the cylinder block, between the two banks of cylinders. To provide continuous and uniform displacement of air, the rotor lobes are made with a helical (spiral) form. Two timing gears, located on the drive end of the rotor shafts, space the rotor lobes with a close tolerance; therefore, as the lobes of the two rotors do not touch at any time, no lubrication is required.

3-57. Testing (on vehicle)

a. Refer to TM 5-3805-240-12 and remove the air cleaner, air inlet housing, and air inlet adapter.

b. Inspect the blower before removal in accordance with the following instructions.

Warning: **When inspecting a blower on an engine with the engine running, keep fingers and**

clothing away from moving parts of blower and run the engine at low speeds only.

(1) Dirt or chips, drawn through the blower, will make deep scratches in the rotors and housing and throw up burrs around such abrasions. If burrs cause interference between the rotors or between the rotors and the housing, the blower should be removed from the engine and the parts dressed down to eliminate interference. If they are too badly scored, replace the rotors.

(2) Leaky oil seals are usually manifest by the presence of oil on the blower rotors or inside surfaces of the housing. This condition may be checked by running the engine at low speed and directing a light into the rotor compartment at the end plates and the oil seals. A thin film of oil radiating away from the seals is indicative of an oil leak.

(3) A worn blower drive, resulting in a rattling noise inside the blower, may be detected by grasping the right-hand helix rotor firmly and attempting to rotate it. The rotors may move from 3/8 inch to 5/8 inch, measured at the lobe crown, with a springing action. When released, the rotors should move back at least 1/4 inch. If the rotors cannot be moved as directed above, or if the rotors move too freely, the flexible blower drive coupling should be inspected and replaced if necessary. The drive coupling is attached to the right-hand helix blower timing gear.

(4) Loose rotor shafts or damaged bearings will cause rubbing and scoring between the crowns of the rotor lobes and the mating rotor roots, between the rotors and the end plates, or between the rotors and the housing. Generally, a combination of these conditions exists. A loose shaft usually causes rubbing between the rotors and the end plates. Worn or damaged bearings will cause rubbing between mating rotor lobes at some point or perhaps allow the rotor assemblies to rub the blower housing. This condition will usually show up at the end where the bearings have failed.

(5) Excessive backlash between the blower timing gears usually results in the rotor lobes rubbing throughout their entire length. Replace badly worn rotors.

(6) The blower inlet screen should be inspected periodically for an accumulation of dirt which, after prolonged operation, may affect the air flow. Servicing of the screen consists of thoroughly washing in fuel oil and cleaning with a stiff brush until screen is free of all dirt deposits.

Note. If blower defects are found during the preceding inspections, remove the blower from the engine and disassemble to the extent necessary to make repairs.

3-58. Removal

a. Remove the governor (para 3-29 & 3-37) and fuel pump. Remove the fuel pump drive fork (4, fig. 3-15) from the blower rotor shaft. Alternatively, the governor and fuel pump may be disconnected (para 3-29) and removed with the blower.

b. Disconnect the tachometer drive cable from the tachometer drive cable adaptor (57, fig. 3-23) and remove adaptor (57) and key (58) from the blower rear end plate cover (21).

c. Loosen the oil pressure line connector (1, fig. 3-23) from the rear of the blower to blower drive support and slide the fitting back on pipe (16).

d. Loosen hose clamp (2) on the blower drive support-to-blower seal.

e. Remove the flywheel housing cover at the blower drive support.

f. Remove retaining ring (3) and withdraw the blower drive shaft (4) from the blower.

g. Open the drain cocks and drain the engine cooling system.

h. Remove the fuel return crossover tube between the cylinder heads.

i. Remove the breather pipe at the top of the cylinder block.

j. Remove the front engine lifter bracket if necessary.

k. Remove bolts (5 and 7) and washers (6 and 8) from the top of each end plate. Remove bolts (9) and retaining washers on each side of the blower.

l. Thread eyebolts in the diagonally opposite tapped holes in the top of the blower housing (11). Then, attach a rope sling and chain hoist to the eyebolts.

m. Lift the blower up slightly and move it forward to detach the blower from the seal at the drive end. Then lift the blower up and away from the engine. Remove blower gasket (12).

n. If the blower, governor, and fuel pump were removed as a unit, cover the air inlet and outlet openings of the blower housing and install the governor cover. Wash the exterior of the blower and governor housing with clean fuel oil and dry with compressed air.

o. Remove the two bolts (13, fig. 3-23) and lockwashers (14) securing the lubricating oil tube seal ring retaining plate (15) to the blower rear end plate cover (21). Remove plate (15), oil pipe

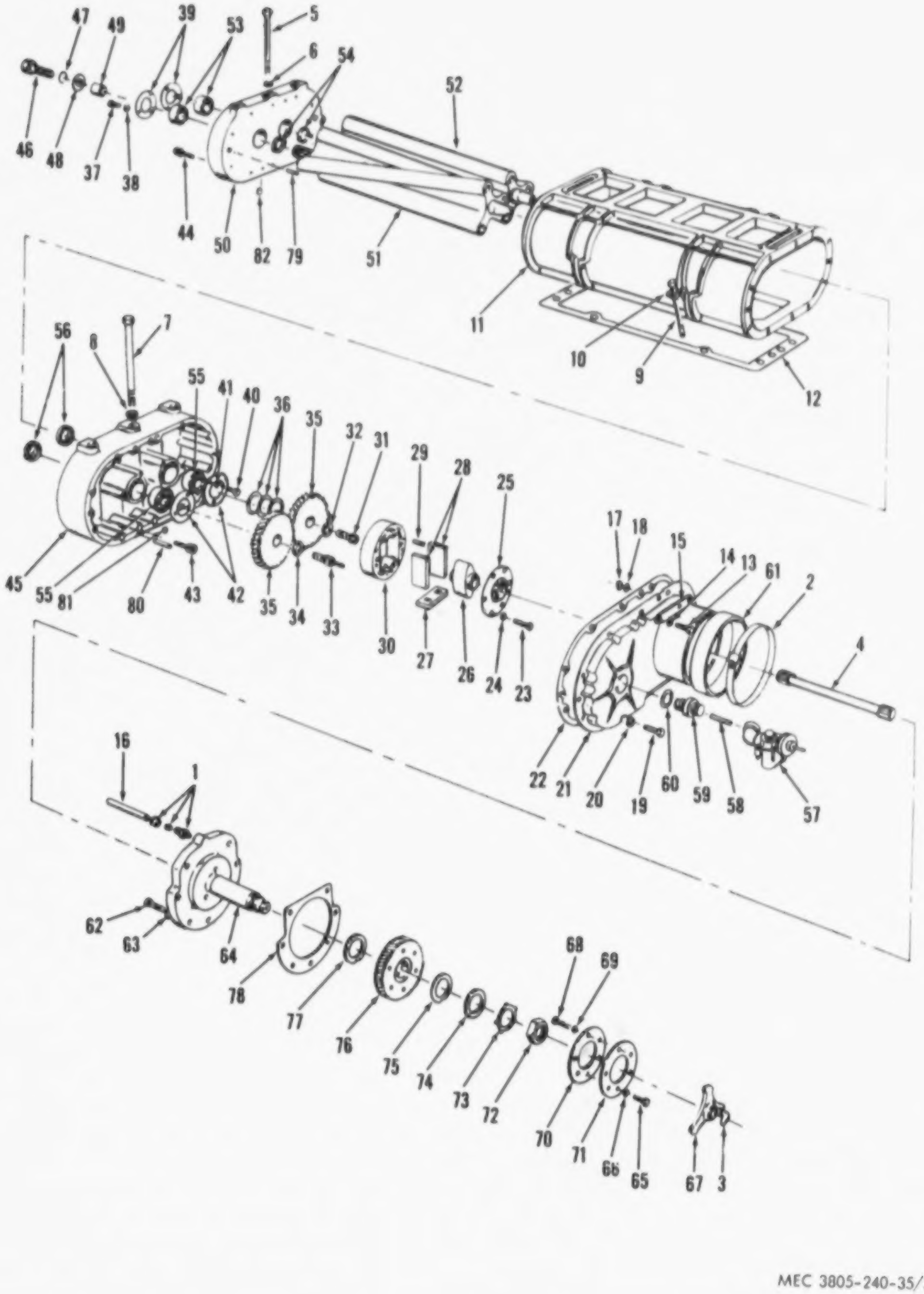

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Figure 3-23. Blower assembly and blower drive assembly, exploded view.

1 Connector, sleeve nut
2 Clamp
3 Ring, retaining
4 Shaft, blower drive
5 Bolt
6 Washer
7 Bolt
8 Washer, lock
9 Bolt
10 Washer, retaining
11 Housing
12 Gasket
13 Bolt (2 rqr)
14 Washer, lock (10 rqr)
15 Plate, retaining
16 Pipe, oil
17 Washer, seal ring
18 Seal ring
19 Bolt (8 rqr)
20 Washer (8 rqr)
21 Cover, rear end plate, blower
22 Gasket
23 Bolt (6 rqr)
24 Washer, lock (6 rqr)
25 Retainer, coupling spring
26 Cam, drive coupling
27 Seat, coupling spring end
28 Spring pack
29 Seat, coupling spring (4 rqr)
30 Support, blower drive coupling
31 Bolt
32 Spacer
33 Shaft, tachometer drive gear
34 Spacer
35 Gear set
36 Shim pack
37 Bolt (12 rqr)
38 Washer, lock (12 rqr)
39 Retainer, bearing (4 rqr)
40 Bolt
41 Washer
42 Retainer, bearing
43 Screw, fillister head (4 rqr)
44 Screw, fillister head (2 rqr)
45 End plate assembly, rear
46 Bolt
47 Washer, lock
48 Disc, fuel pump drive
49 Spacer
50 End plate assembly, front
51 Rotor, LH helix
52 Rotor, RH helix
53 Bearing, ball (2 rqr)
54 Seal, end plate (4 rqr)
55 Bearing, ball (2 rqr)
56 Seal, end plate
57 Adapter, tachometer drive
58 Key
59 Fitting
60 Seal
61 Seal
62 Bolt
63 Washer, copper
64 Support assembly
65 Bolt
66 Washer, lock
67 Hub, coupling
68 Bolt
69 Washer, lock
70 Plate, spring
71 Plate, spring
72 Nut
73 Washer, lock, tab
74 Washer
75 Bearing, thrust
76 Gear assembly, drive
77 Bearing, thrust
78 Gasket
79 Pin, dowel (2 rqr)
80 Pin, dowel (2 rqr)
81 Strainer (2 rqr)
82 Strainer

Figure 3-23—Continued

(16), seal ring washer (17) and seal ring (18) from the blower end plate cover (21).

p. Remove bolts (19) and lockwashers (20) securing end plate cover (21) to the rear end plate (45). Remove the cover and gasket (22) from the end plate.

q. Remove the six bolts (23) and lockwashers (24) securing the blower drive coupling to the right-hand blower rotor gear (35). Remove the retainer (25) and drive coupling assembly from the gear.

r. Note the location of the two copper washers, one plain washer, and eight lockwashers on the governor-to-blower bolts before removing them. Then, remove the ten bolts and washers (two inside and eight outside) securing the governor and fuel pump assembly to the blower.

s. Tap the sides of the governor housing lightly with a plastic hammer to loosen the governor from the blower. Then, pull the governor and fuel pump assembly from the dowels in the blower end plate. Remove the fuel pump drive coupling fork and the governor housing gasket.

3-59. Disassembly

a. Place a clean folded cloth between the rotors and remove the Allen head bolt (31) and spacer (32) from the right-hand gear (35). Remove the tachometer drive gear shaft (33) and spacer (34) from left-hand gear (35).

b. Remove the timing gears (35) with two pullers (fig. 3-24). Pull both gears at the same time as follows:

(1) Back out the center screws of both pullers and place the flanges against the gear faces, alining the flange holes with the tapped holes in the gears. Secure the pullers to the gears with 5/16-24NF x 1 1/2 inches long bolts (two bolts on the LH helix gear and three bolts on the RH helix gear).

(2) With a clean cloth placed between the rotors to prevent their turning, turn the two puller screws uniformly clockwise and withdarw the gears from the rotor shafts as shown in figure 3-24.

c. Remove the shims (36, fig. 3-23) from the shafts of rotors (51 and 52) after the gears have been removed. Note the number and thickness of shims on each rotor shaft to ensure identical replacement when reassembling the blower.

d. Remove the bolts (37 and 40) and lockwashers (38) securing the rotor shaft bearing retainers (39 and 42) to both front and rear end plates (50 and 45). Remove the retainers.

e. Remove the blower rear end plate (45) with bearings (55) from the blower housing (11) and rotors (51 and 52) with the two pullers (fig. 3-24) as follows:

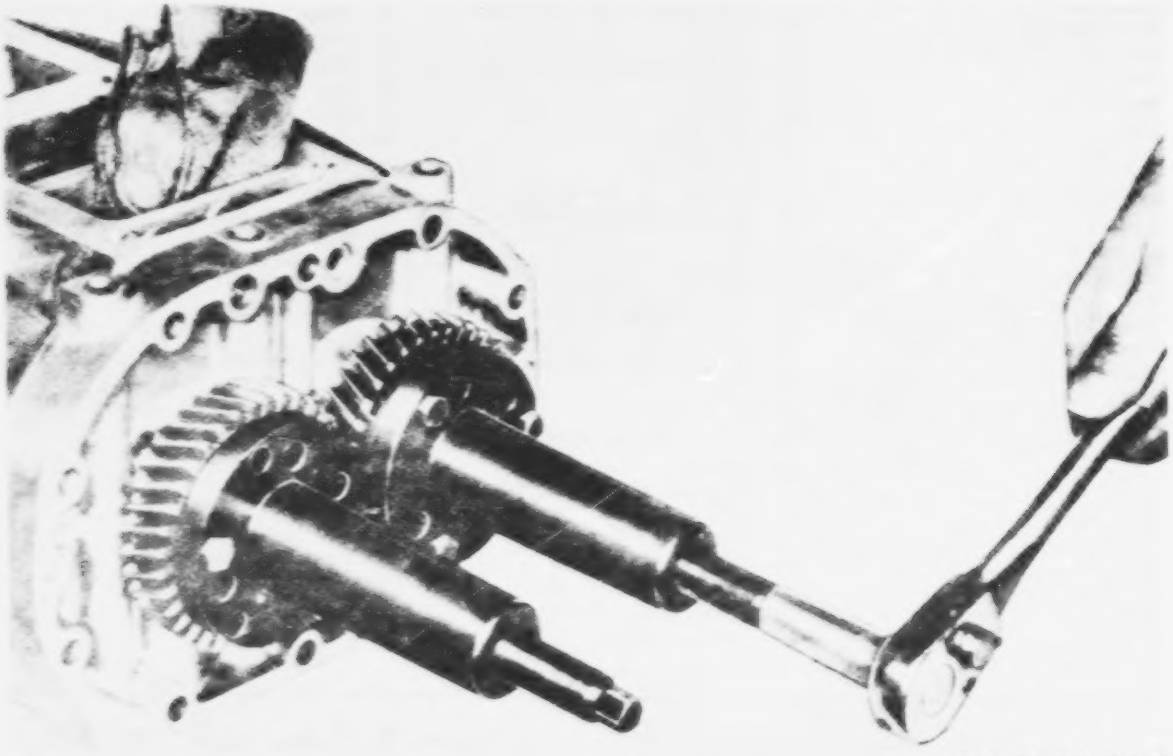
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Figure 3-24. Removing blower gears.

(1) Remove the two fillister head screws (43, fig. 3-23) securing the rear end plate (45) to the blower fillister head screws (44) securing the front end plate (50) to the housing approximately three turns.

(2) Back out the center screws of the pullers far enough to permit the flange of each puller to lay flat on the face of the end plate.

(3) Aline the holes in each puller flange with the tapped holes in the end plate and secure the pullers to the end plate with six 1/4-20NC x 1 1/4 inches long bolts.

Caution: **Be sure that the 1/4-20NC bolts are threaded all the way into the tapped holes in the end plate to provide maximum anchorage for the pullers and to eliminate possible damage to the end plate.**

(4) Turn the two puller screws uniformly clockwise and withdraw the end plate and bearings from the blower housing and rotors.

f. Remove the blower front end plate (50) in the same manner as described in step (5) above using the pullers.

g. Withdraw the blower rotors (51 and 52) from the housing (11).

h. If necessary, remove the bearings (53 and 55) and oil seals (54 and 56) from the blower end plates (50 and 45) as follows:

(1) Inspect the oil seals. If the seals are scored, charred or hardened so that a tight seal around the shafts is impossible, install new seals. If necessary, the seals may be removed from the end plates at the same time the individual bearings are removed.

(2) Support the outer face of the end plate on wood blocks on the bed of an arbor press.

(3) Press the bearing and oil seal out of the end plate.

(4) Remove the remaining bearings and oil seals from the end plates in the same manner.

3-60. Cleaning

a. Wash all of the blower parts in clean fuel oil and dry with compressed air.

b. Clean the oil strainer in the vertical oil passage at the bottom of each blower end plate, and blow out all oil passages with compressed air.

3-61. Inspection and Repair

a. Examine the bearings for any indications of corrosion or pitting. Lubricate each bearing with light engine oil; then, while holding the bearing inner race from turning, revolve the outer race slowly by hand and check for rough spots. The double-row ball bearings are preloaded and have no end play. A new double-row bearing will seem to have considerable resistance to motion when revolved by hand.

b. Inspect the blower rotor lobes, especially the sealing ribs, for burrs and scoring. Rotors must be smooth for efficient operation of the blower. If the rotors are slightly scored or burred, they may be cleaned up with emery cloth. Examine the rotor shaft serrations for wear, burrs or peening. Also, inspect the bearing and oil seal contact surfaces of the shafts for wear and scoring.

c. Inspect the inside surface of the blower housing for burrs and scoring. The inside surface must be smooth for efficient operation of the blower. If the inside surface of the housing is slightly scored or burred, it may be cleaned up with emery cloth. Check the finished ends of the blower housing, which receive the end plates, for flatness and burrs. The end plates must set flat against the blower housing. The finished inside face of each end plate must be smooth and flat. If the finished face is slight scored or burred, it may be cleaned up with emery cloth.

d. Examine the serrations in the blower timing gears for wear and peening; also check the teeth for wear, chipping or damage. If the gears are worn to the point where the backlash between the gear teeth exceeds 0.004 inch, or are damaged sufficiently to require replacement, replace both gears as a set.

e. Check the blower drive shaft serrations for wear or peening. Replace the shaft if it is bent.

f. Inspect the blower drive coupling springs (pack) and the cam for wear.

3-62. Reassembly

a. To assure proper assembly of rotors and gears for correct blower timing, observe the following precautions.

(1) The lobes on the *driving* blower rotor and the teeth on its gear form a right-hand helix while the lobes and teeth of the *driven* rotor and gear form a left-hand helix. Hence, a rotor with right-hand helix lobes must be used with a gear having right-hand helix teeth and vice versa.

(2) One serration is omitted on the drive end of each blower rotor shaft and a corresponding serration is omitted in each gear. Assemble the gears on the rotor shafts with the serrations in alignment.

(3) The rotors must be assembled in the blower housing with the omitted serrations in the rotor shafts alined as shown in figure 3-25.

b. Install the oil seals (54 and 56, fig. 3-23) in the end plates (50 and 45) as follows:

(1) Support either blower end plate, finished surface up, on wood blocks placed on the bed of an arbor press.

(2) Start the oil seal straight into the bore in the end plate with the sealing edge facing down (toward the bearing bore).

(3) Press the oil seal into the end plate until the shoulder on the installer contacts the end plate.

Note. A step under the shoulder of the installer will position the oil seal approximately 0.005 inch below the finished face of the end plate. The seal shall be 0.002 to 0.008 inch below the finished face.

(4) Install the remaining oil seals in both end plates in the same manner.

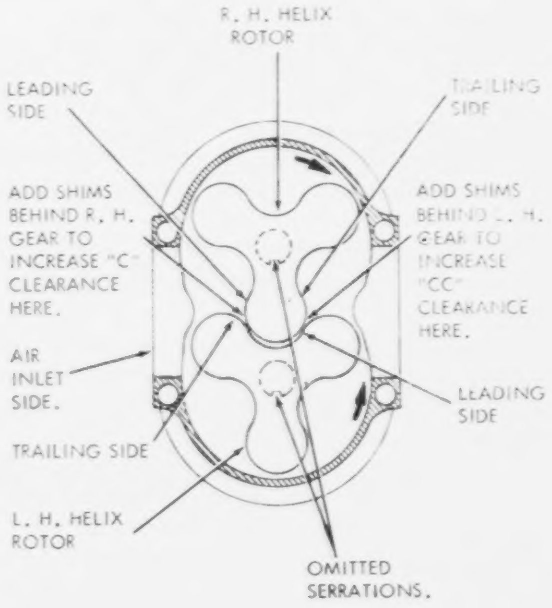
R. H. HELIX ROTOR
LEADING SIDE
TRAILING SIDE
ADD SHIMS BEHIND R. H. GEAR TO INCREASE "C" CLEARANCE HERE.
ADD SHIMS BEHIND L. H. GEAR TO INCREASE "CC" CLEARANCE HERE.
AIR INLET SIDE.
LEADING SIDE
TRAILING SIDE
L. H. HELIX ROTOR
OMITTED SERRATIONS.

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Figure 3-25. Rotor lobe location and clearances.

c. Install the front end plate (50) to the blower housing (11) as follows:

Caution: **The oil hole on the top of the *front* end plate is plugged. Do not install this end plate on the rear end of the blower housing.**

(1) If removed, press a new oil strainer (82) into the vertical oil passage at the bottom side of the end plate from flush to 0.015 inch below the bottom surface.

(2) Check the dowel pins (79). The dowel pins must project 0.380 inch from the flat innerface of the front end plate to assure proper alinement of the end plate with the housing.

(3) Place the blower housing (11) on a bench with the top side of the housing up, and the front end of the housing facing the outside of the bench.

Note. The top of the end plate has one oil hole and the bottom has three oil holes.

(4) Position the end plate (50) in front of the blower housing with the top side of the end plate facing up. Then, start the dowel pins straight into the dowel pin holes in the housing. Push or tap the end plate against the housing. Note that no gaskets are used between the end plates and the housing; therefore, the mating surfaces must be perfectly flat and smooth.

(5) Insert the two fillister headscrews (44) through the end plate and thread them into housing. Tighten the screws securely. Do not use lockwashers on these screws.

d. Install the blower rotors (51 and 52) in the blower housing (11) and end plate (50) as follows:

(1) Reverse the blower housing on the bench (rear end of housing facing the outside of the bench).

(2) Place the rotors in mesh with the omitted serrations in the rotor shafts in a horizontal position and facing to the left as viewed from the gear end (fig. 3-25).

Note. The right-hand helix rotor is marked "gear end" on one end. The gear end of the left-hand rotor is that end which has the serrated shaft.

(3) Install a special oil seal pilot over the end of each rotor shaft that passes through the oil seals in the front end plate.

(4) Insert the rotors straight into the housing and through the front blower end plate.

(5) Remove the special oil seal pilots from the rotor shafts.

e. Install the blower rear end plate (45, fig. 3-23) as follows:

(1) Install a special oil seal pilot over the serrated end of each rotor shaft.

(2) Check the dowel pins (80). The dowel pins must project 0.270 inch from the flat inner face of the rear end plate to assure proper alinement of the end plate with the housing.

(3) Position the end plate in front of the housing. With the top of the end plate up (one oil hole) and its flat finished face towards the blower housing. Slide the end plate straight over the oil seal pilots and start the dowel pins straight into the dowel pin holes in the housing. Then, push or tap the end plate against the housing.

(4) Insert the two fillister headscrews through the end plate and thread them into the housing. Tighten the screws securely. Do not use lockwashers on these screws.

(5) Remove the oil seal pilots from the rotor shafts.

f. With the blower housing, rotors and the end plates still supported in a vertical position on the two wood blocks, install the ball bearings (55) on the rotor shafts and in the rear end plate as follows:

(1) Lubricate one of the ball bearings with light engine oil. Start the bearing, numbered end up, straight on one of the rotor shafts.

(2) Place bearing installer on top of the bearing and tap the bearing straight on the rotor shaft and into the rear end plate.

(3) Install the second ball bearing on the remaining rotor shaft in the same manner.

(4) Place the bearing retainers (42) on top of the bearings (55) and the end plate; then, install the retainer bolts (40) and lock-washers (38). Tighten the bolts to 7-9 foot-pounds torque.

g. Install the roller bearings (53) on the rotor shafts and in the front end plate (50) as follows:

(1) Reverse the position of the blower housing on the two wood blocks.

(2) Lubricate one of the roller bearings with light engine oil. Start the bearing, numbered end up, straight on one of the rotor shafts.

(3) Place bearing installer on top of the bearing and tap the bearing straight on the shaft and into the front end plate.

(4) Install the second roller bearing on the remaining rotor shaft in the same manner.

(5) Place the bearing retainers (39) on top of the bearings (53) and the end plate; then, install the retainer bolts (37) and lockwashers (38). Tighten the bolts to 7-9 foot-pounds torque.

h. Make a preliminary check of the rotor-to-end plate and rotor-to-housing clearances at this time with a feeler gage (fig. 3-26). Refer to figure 3-27 for minimum blower clearances.

i. Before installing the blower rotor timing gears on the rotor shafts, observe precautions "(2)" and "(3)" relative to the rotor shaft and timing gear alinement in the NOTE at the beginning of reassembly. The center punch mark in the end of each rotor shaft at the omitted serration will assist in aligning the gears on the shafts.

j. If shims were removed from the back side of the gears (between the inner race of the bearing and the gear), they should be replaced in their original positions before installing the gears on their respective shafts.

k. Install the blower timing gears (35, fig. 3-23) as follows:

(1) Place the blower assembly on the bench, with the top of the housing up and the rear end (serrated end of rotor shafts) of the blower facing the outside of the bench.

(2) Rotate the rotors to bring the omitted serrations on the shafts in alinement and facing to the left.

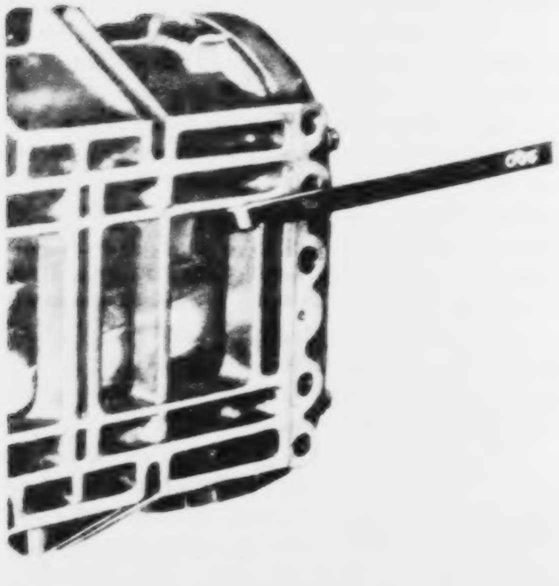

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Figure 3-26. Checking rotor to end plate clearance.

(3) Install the same number and thickness of shims (36) on the rotor shafts (51 and 52) that were removed at the time of disassembly.

(4) Lubricate the serrations of the rotor shafts with light engine oil.

(5) Place the teeth of gears (35) in mesh so that the omitted serrations inside the gears are in alinement and facing the same direction as the omitted serrations on the shafts.

(6) Start both rotor gears straight on the rotor shafts with the right-hand helix gear on the right-hand helix rotor and the left-hand helix gear on the left-hand helix rotor, with the omitted serrations in the gears in line with the omitted serrations on the rotor shafts.

(7) Thread a 1/2-20NF x 1 1/4 inch long bolt with a large plain washer into the end of each rotor shaft. Place a clean folded cloth between the lobes of the rotors to prevent the gears from turning. Draw the gears into position tight against the shims and the bearing inner races with the 1/2-20NF bolts.

(8) Remove the two bolts and washers that were used to draw the gears into position on the rotor shafts.

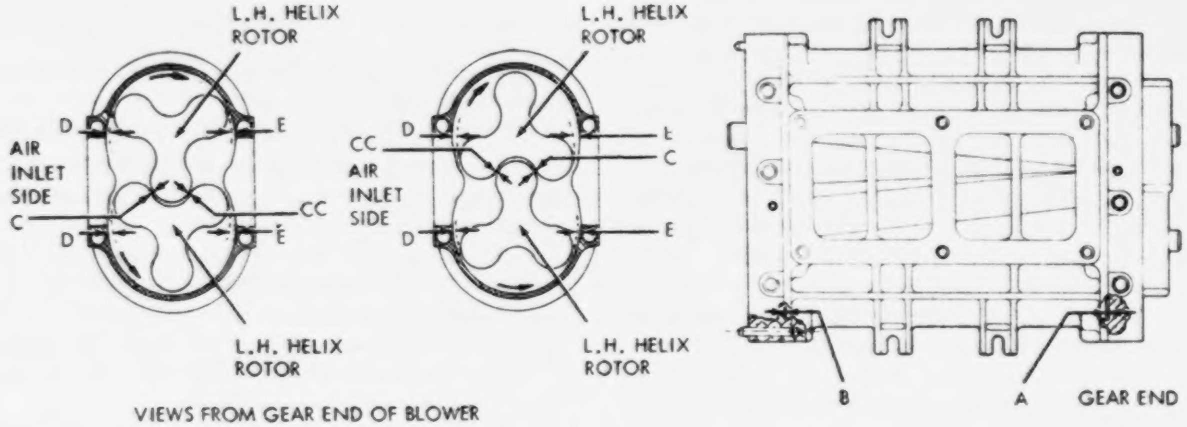
(9) Lubricate the threads of the Allen head gear retaining bolt (31) and tachometer drive gear shaft (33) with engine oil. Place a spacer (32 and 34) on the bolt (31) and shaft (33) and thread them into the rotor shafts. Tighten to 55-65 foot-pounds torque.

Note. The blower timing gear retaining bolt and tachometer drive gear shaft incorporate a special nylon insert and must be lubricated before installation in the rotor shafts.

l. Timing Blower Rotors. After the blower rotors and timing gears are installed, the blower rotors must be timed as follows:

Note. Before timing the blower, install four 5/16-18NC x 1 7/8 inch long bolts with flat washers through four bolt holes in each end plate (top and bottom) and thread them into the blower housing. Tighten the bolts to 13-17 foot-pounds torque. This will hold the end plates against the blower housing so the proper clearance between rotors and the end plate can be obtained.

(1) The blower rotors, when properly positioned in the housing, run with a slight clearance between the lobes. This clearance may be varied by moving one of the helical gears in or out on the shaft relative to the other gear. If the right-hand helix gear is moved out, the right-hand helix rotor will turn counterclockwise when viewed from the gear end. If the left-hand helix gear is moved out, the left-hand helix rotor will turn clockwise when viewed from the gear end. This



NOTE: Time rotors to dimensions on chart for clearance between trailing side of R.H. Helix Rotor and leading side of L.H. Helix Rotor (cc) from both inlet and outlet side of blower.

A	B	C	CC	D	E
.007"	.012"	.012"	.002" TO .006"	.016"	.004"

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Figure 3-27. Blower clearance chart.

positioning of the gear, to obtain the proper clearance between the rotor lobes, is known as blower timing.

(2) Moving the gears OUT or IN on the rotor shafts is accomplished by adding or removing shims (36) between the gears (35) and the bearings (55).

(3) The clearance between the rotor lobes may be checked with 1/2 inch wide feeler gages. When measuring clearances of more than 0.005 inch, laminated feeler gages that are made up of 0.002 inch or 0.005 inch feeler stock are more practical and suitable than a single feeler gage. Clearances should be measured from both the ilnet and outlet sides of the blower (fig. 3-28).

(4) Time the rotors to have from 0.002 inch to .0006 inch clearance between the TRAILING edge of the right-hand helix rotor and the LEADING edge of the left-hand helix rotor ("CC" clearance) measured from both the inlet and outlet sides as shown in figures 3-28 and 3-27. If possible, keep this clearance to the minimum (0.002 inch). Then, check the clearance between the LEADING edge of the left-hand helix rotor ("C" clearance) for the minimum clearance of 0.012 inch. Rotor-to-rotor measurements should be taken 1 inch from each end, and at the center of blower.

(5) After determining the amount one rotor must be removed to obtain the proper clearance, add shims back of the proper gear to produce the desired result (fig. 3-25). When more or less shims are required, both gears must be removed from the rotors. Placing a 0.003 inch shim in back of a rotor gear will revolve the rotor 0.001 inch.

(6) Install the required thickness of shims back of the proper gear and next to the bearing inner race and reinstall both gears. Recheck the clearances between the rotor lobes.

(7) Determine the minimum clearances of points "A" and "B" (fig. 3-27). Insert the feeler gages between the end plates and the ends of the rotors (fig. 3-26). This operation must be performed at the ends of each lobe, making 12 measurements in all. See figure 3-27 for the minimum clearances.

(8) Check the clearance between each rotor lobe and the blower housing at both the inlet

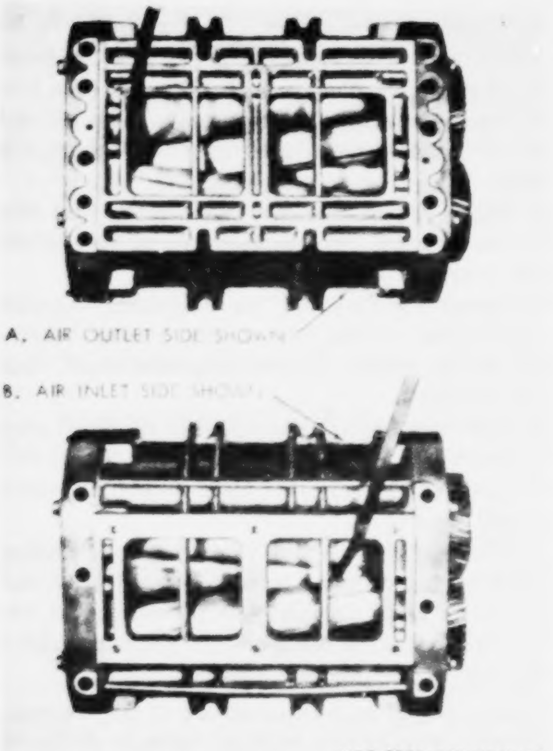

Figure 3-28. Checking clearance between rotor lobes.

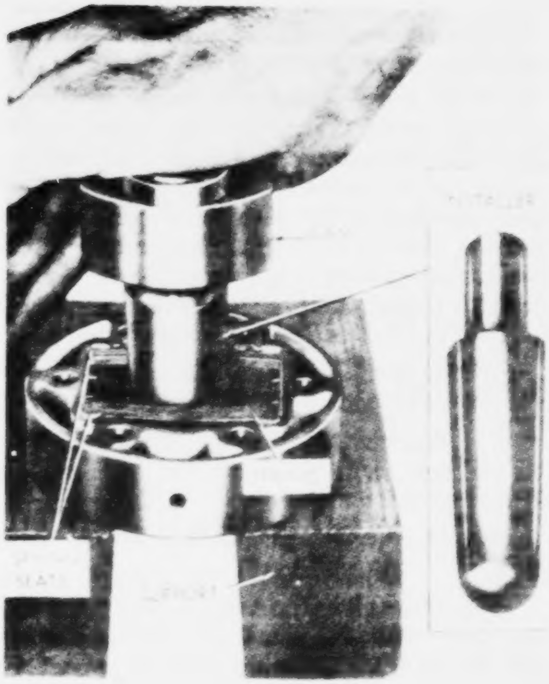

Figure 3-29. Installing blower drive cam.

and outlet side—twelve measurements in all. See figure 3-27 for the minimum clearances.

m. After the blower rotors are timed, complete the assembly of the blower.

n. Place the fuel pump drive disc spacer (49, fig. 3-23) over the forward end of the right-hand helix rotor shaft. Then, place the special lock-washer (47) and the drive disc (48) on the retaining bolt (46) and thread the bolt into the rotor shaft against the spacer. Tighten the bolt to 83-93 foot-pounds torque. Bend one tang of the lock-washer over into the slot in the drive disc and two tangs over against the flat sides of the bolt head.

o. If disassembled, install the springs (28) and blower drive cam (26) in the blower drive coupling support (30) as follows:

(1) Place the drive coupling support (30) on two wooden blocks.

(2) Apply a light coat of grease to the back of the spring seats. Place the half-round spring seats in the grooves inside the support, and the flat spring seats inside the support at each end of the opening (fig. 3-29).

(3) Coat the springs with light engine oil. Place the spring packs (28, fig. 3-23) into the support (30) with the spring seats in position as shown in figure 3-29.

(4) Place the drive cam (26, fig. 3-23) over the end of installer with the large chamfered end of the cam facing up. Insert the tapered installer between the spring packs (fig. 3-29) until the cam is centered between the spring packs. Remove the installer.

p. Place the spring retainer (25, fig. 3-23), flat side down, over the inside diameter end of the cam (26) and against the support (30) with the bolt holes in the retainer and support in alinement. Place the support and retainer assembly against the right-hand helix gear, align the bolt holes and install the six bolts (23) and lock-washers (24). Center the drive support on the gear and tighten the bolts to 20-25 foot-pounds torque.

Caution: **The blower drive coupling support must be centered on the gear to prevent misalinement of the blower drive shaft.**

q. Remove the four bolts and flat washers holding each end plate to the blower housing. (These bolts were installed to permit timing the blower.)

r. Affix a new gasket (22) to the blower rear end plate cover (21). Place the cover over the gears and against the end plate (45), with the opening in the cover over the blower drive coupling attached to the right-hand helix gear. Install the eight bolts (19), lockwashers (20) and special flat washers in the eight holes at each end and the bottom side of the cover. Tighten the bolts to 13-17 foot-pounds torque.

s. Attach the lubricating oil pipe (16) and seal ring retaining plate (15) to the blower as follows:

(1) Insert a new oil tube seal ring (18) in the oil hole counterbore at the top rear face of the rear end plate.

(2) If removed, place connector (1) on the oil pipe.

(3) Place oil seal retaining plate (15) on oil pipe (16) with the sharp bevelled end of the plate to the left and facing down as viewed from the rear of the blower. Then, place the seal ring retaining flat washer (17) on the oil pipe.

(4) Insert the end of the oil pipe through the seal ring (18) in the counterbore of the end plate. Push the flat washer against the seal ring and the retaining plate against the cover. Install the two bolts (13) and lockwashers. Do not tighten the bolts until after the blower assembly has been installed on the cylinder block.

t. Attach the governor and fuel pump assembly to the blower as follows:

(1) Affix a new gasket to the forward face of the blower end plate.

(2) Place the fuel pump drive fork on the fuel pump shaft. Position the governor and fuel pump assembly in front of the blower. Rotate the fuel pump fork until the prongs of the fork align with the slots in the drive disc. Rotate the weight shaft and aline the splines on the shaft with the splines in the blower rotor.

(3) Push the governor straight on the dowel pins in the blower end plate and against the gasket.

(4) Refer to figure 3-14 (para 3-28) for correct location, and install the bolts, lockwashers, copper washer and plain washer which secure the governor to the blower. Tighten the bolts to 13-17 foot-pounds torque.

3-63. Installation

a. Fasten a new gasket (12, fig. 3-23) to the cylinder block with a good grade of gasket cement.

b. If removed, place a fuel rod cover tube hose and clamp on each fuel rod cover tube at each side of the governor housing, and tighten the clamps.

c. Place the blower end plate cover seal ring (61) and clamp (2) on the end of the blower drive support (64).

d. Thread eyebolts in the diagonally opposite tapped holes in the top of the blower housing (11). Then, attach a rope sling and chain hoist to the eyebolts.

e. Lift the blower assembly at a slight angle and position it on top of the cylinder block, with the flange of the rear end plate cover (21) inside the seal ring (61).

f. Thread bolts (5 and 7) and special washers (6 and 8) finger tight in the center hole of each blower end plate (50 and 45). Then, thread bolts (19) and retaining washers (10) finger tight at each side of the blower housing.

Note. The lip at the bevelled end of the bolt retaining washer (10) goes in the small recess in the housing just above the bolt slots.

g. Tighten the bolts as follows:

(1) First, tighten the blower-to-block end plate bolts (5 and 7) to 40-45 foot-pounds torque.

(2) Then, tighten the blower housing-to-block side angle bolts (9) uniformly to 30-35 foot-pounds torque in 5 foot-pound increments.

(3) Recheck the blower-to-block end plate bolts (5 and 7).

h. Place the blower rear end plate cover seal ring (61) and hose clamp (2) into position and tighten the hose clamp.

i. Connect the lubricating oil pipe (16) to the connector (1) in the blower drive support. Then, tighten the two seal ring retaining plate bolts (13) to 13-17 foot-pounds torque.

j. Insert the blower drive shaft (4) through the blower drive flexible coupling hub (67) and into the blower drive coupling support (30), and install the retaining ring (3) in the flexible coupling. Then, attach the flywheel housing cover to the flywheel housing.

k. Slide each fuel rod cover tube hose down on the cover tubes attached to the cylinder heads and tighten the hose clamps.

l. Install the fuel rods between the cylinder heads and governor (para 3-34).

m. Refer to paragraph 3-34 and complete the installation of the governor.

n. Attach the generator and support bracket to the cylinder head and connect the wires to the generator.

o. Install and connect the crossover fuel oil line to each cylinder head, and connect the fuel oil lines to the fuel pump.

p. Install the tachometer drive cable adaptor (57) and key (58) and attach the tachometer drive cable.

q. If removed, install the front engine lifter bracket.

r. Place the water bypass tube between the two thermostat housings and slide the hoses part way on the thermostat housings. Position the bypass tube so it clears the governor, fuel pump and fuel oil lines. Then, tighten the hose clamps.

s. Attach the air inlet adapter to the blower and the air inlet housing assembly to the adapter (para 3-55).

t. Refer to TM 5-3805-240-12 and install the air cleaner.

u. Connect the wire assembly to the air shutdown cam at the side of the air inlet housing.

v. Connect the throttle control rods to the speed control and stop levers on the governor.

w. Close the drain cocks and fill the engine cooling system.

x. Refer to TM 5-3805-240-12 and adjust the governor and injector rack controls.

y. Check for and correct any water or oil leaks.

Section X. LUBRICATING OIL PUMP AND PRESSURE REGULATOR AND RELIEF VALVE ASSEMBLIES

3-64. General

The gear-type scavenging oil pump is mounted on the number 1 and 2 main bearing caps and is driven by an oil pump drive gear mounted on the crankshaft (fig. 3-30). An opening is provided on the oil pump body for mounting an oil pump inlet pipe and screen assembly. A scavenging oil pump inlet pipe and screen is mounted on the oil pump scavenging body. Oil is drawn by suction from the oil pan through the oil pump inlet screen and pipe into the oil pump where it is pressurized.

3-65. Removal

a. Remove the drain plugs from the oil pan and drain the oil.

b. Remove the oil pan bolts and remove the oil pan. Clean all traces of the gasket from both the oil pan and the cylinder block.

c. Remove two mounting bolts (1, fig. 3-31) and lock washers (2) and remove the oil pressure regulator valve (3) from the cylinder block.

d. Remove the four bolts (9, 10) and lock washers (11) which attach the oil pressure relief valve (12) to the oil pump body and cylinder block.

e. Remove two self-locking bolts (22) and lift the screen (24) off the inlet pipe. Remove two bolts (25) and remove the oil pump inlet pipe (27).

f. Remove the two bolts (32) and lock washers (33) which attach the oil pump scavenging inlet pipe (34) and baffle plate (36) to the scavenging pump body. Remove the scavenging inlet pipe and baffle plate.

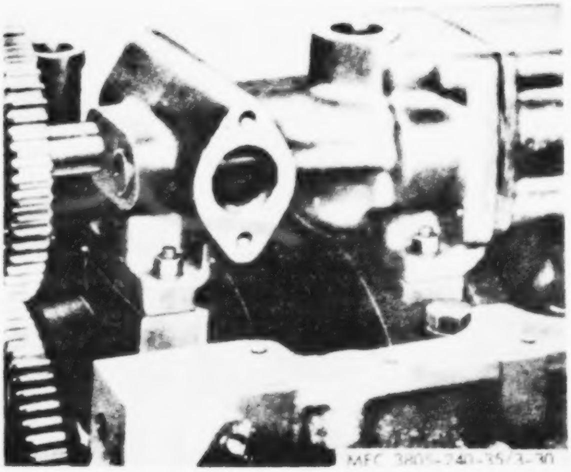

Figure 3-30. Lubricating oil pump mounting.

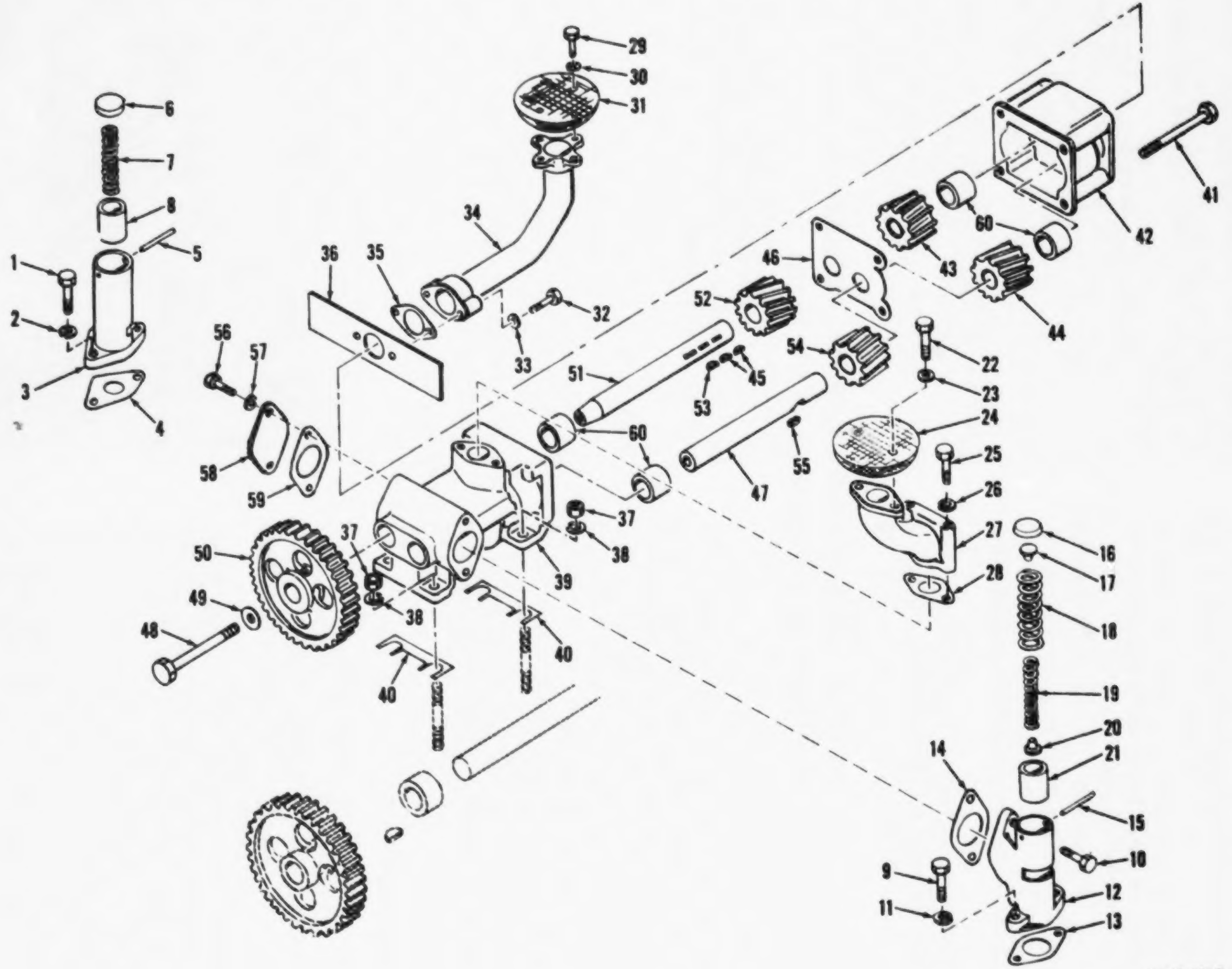
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Figure 3-31. Lubricating oil pump, regulator and relief valves, exploded view.

1	Bolt (2 rqr)
2	Lockwasher (2 rqr)
3	Pressure regulator valve body
4	Gasket
5	Pin
6	Spring seat
7	Spring
8	Valve
9	Bolt (2 rqr)
10	Bolt (2 rqr)
11	Lockwasher (4 rqr)
12	Body, pressure relief valve
13	Gasket
14	Gasket
15	Pin
16	Spring seat, outer
17	Spring seat, inner
18	Outer spring
19	Inner spring
20	Inner spring seat
21	Valve
22	Bolt (2 rqr)
23	Flat washer (2 rqr)
24	Screen
25	Bolt (2 rqr)
26	Lockwasher (2 rqr)
27	Oil pump inlet pipe
28	Gasket
29	Bolt (2 rqr)
30	Flat washer (2 rqr)
31	Screen
32	Bolt (2 rqr)
33	Lockwasher (2 rqr)
34	Scavenging inlet pipe
35	Gasket (2 rqr)
36	Baffle plate
37	Nut (4 rqr)
38	Lockwasher (4 rqr)
39	Oil pump body
40	Shim (as required)
41	Bolt (4 rqr)
42	Scavenging pump body
43	Scavenging drive gear
44	Scavenging driven gear
45	Woodruff key (2 rqr)
46	Spacer
47	Driven shaft
48	Bolt, special
49	Washer, special
50	Driven Gear, oil pump
51	Drive shaft
52	Drive gear
53	Woodruff key
54	Driven gear
55	Woodruff key
56	Bolt (2 rqr)
57	Lockwasher (2 rqr)
58	Cover
59	Gasket
60	Bushing (4 rqr)

Figure 3-31—Continued

g. Remove the nuts (37) and lock washers (38) which attach the oil pump to the main bearing caps. Then remove the oil pump assembly (39).

Note. Shims (40) are used between the oil pump mounting feet and the main bearing caps. Whenever the original pump is reinstalled, the same shims or an equal number of new (identical) shims must be placed under both the front and rear mounting feet and the number then adjusted to obtain the proper clearance between the gears.

3-66. Disassembly

Disassemble the oil pump in the numerical sequence as illustrated on figure 3-31.

3-67. Cleaning

Wash all of the parts in clean fuel oil and dry them with compressed air.

3-68. Inspection and Repair

a. Examine the gear cavity in the oil pump and scavenging pump body. Replace scored pump bodies.

b. Inspect the bushings (60) in both pump bodies (39) and (42). Replace badly worn bushings. The shaft-to-bushing clearance with new parts is 0.0015 inches to 0.0032 inches.

c. If the gear teeth are scored or worn, install new gears (43, 44, 52 and 54). Gears should have a free-running fit (with no perceptible looseness). Excessively worn gears cause low engine oil pressure which may lead to serious engine damage.

d. Inspect gear shafts for wear and check the keyways. Replace the shafts if necessary as shown on figure 3-32.

e. Inspect the external oil pump drive gear for wear and replace it if necessary.

f. The regulator valve must move freely in the valve body. If the valve is scored and cannot be cleaned up with crocus cloth, the valve must be replaced.

g. Replace the spring when a load of approximately 34 lbs. or less will compress it to 2.5 inches. Use spring tester (fig. 3-33) and an accurate torque wrench to check the spring load.

3-69. Reassembly

a. Reassemble the oil pump in reverse of the numerical sequence as illustrated on figure 3-31.

b. Gear and shaft reassembly procedure.

(1) Insert the Woodruff key (53, fig. 3-31) in the keyway of the oil pump drive shaft (51) and apply a light coat of engine oil on the shaft.

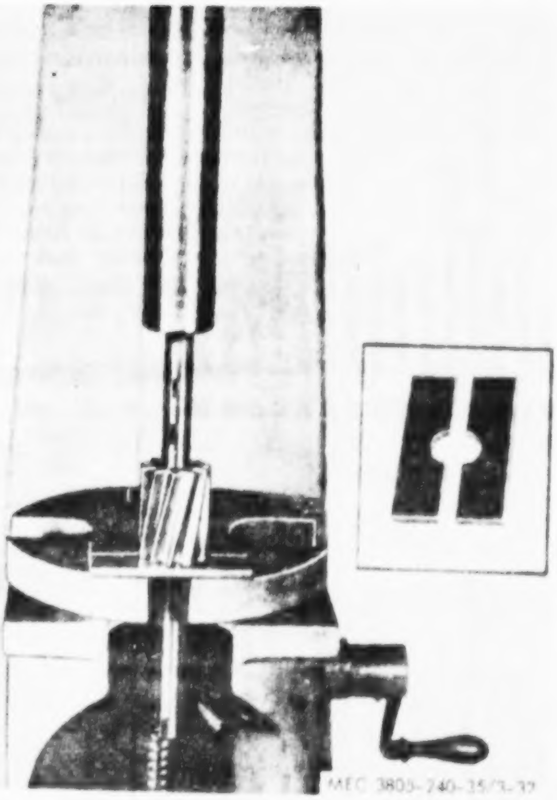

Figure 3-32. Pressing oil pump gear from shaft.

(2) Press the drive shaft into the oil pump drive gear (52). Position the gear 7.97 inches from the end of the drive shaft as shown in figures 3-34 and 3-35.

(3) Insert the Woodruff key (55) in the keyway of the driven shaft (47). Apply a light coat of engine oil on the shaft. Press the shaft in the driven gear (54). Position the gear 6.01 inches from the end of the shaft as shown in figures 3-34 and 3-35.

(4) Install the drive shaft and gear as an assembly (51, 52 and 53) in the oil pump body (39).

(5) Install the oil pump driven gear (50) on the drive shaft (51). Place the washer (49) on the bolt (48) and tighten the bolt to 60-65 lb-ft torque.

(6) Install the driven shaft and gear as an assembly (47, 54 and 55) in the pump body.

(7) Slide the spacer (46) on the shafts (47 and 51). Insert the two remaining Woodruff keys (45) in the drive shaft (51). Slide the scavenging pump gears (43 and 44) on the shafts (47 and 51).

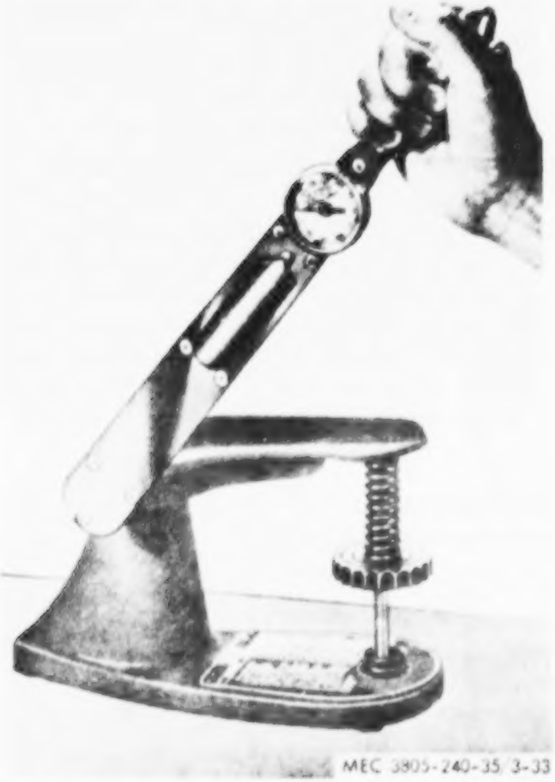
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Figure 3-33. Checking spring load.

Caution: **The scavenging pump drive and driven gears (43 and 44) must be in the same relative position as the oil pump and driven gears (52 and 54).**

(8) Secure the scavenging pump body (42) to the oil pump body (39) with four self locking bolts (41).

(9) Place a new gasket (59) on the oil pump body side cover (58) and fasten it to the pump body with two bolts (56) and lock washers (57).

Caution: **The oil pump gears must turn freely after assembly. Any bind in the pump must be eliminated before it is installed on the engine.**

3-70. Installation

a. Refer to paragraph 3-65 and install the oil pump and pressure valves.

b. Use new gaskets for entire installation.

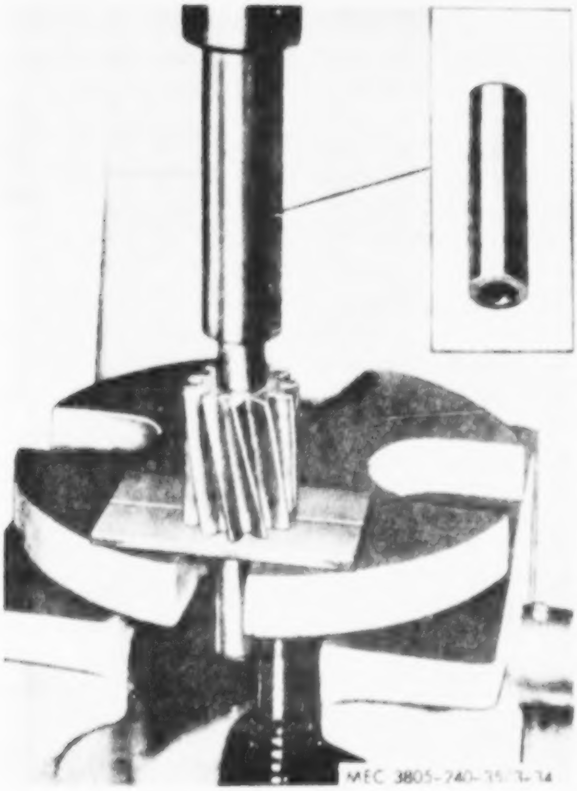
MEC 3805-240-35/3-34

Figure 3-34. Installing oil pump gear for shaft.

c. Place the same number of shims (40) between the oil pump feet and the main bearing caps as were removed. Removing or installing shims controls the gear tooth adjustment. The addition or removal of one set of .005 inches shims will change the gear tooth clearance by .0005 inches.

d. With the engine in the running position check the tooth clearance between the oil pump gear and the crankshaft gear. Use a feeler gage or a suitable indicator. The clearance should be .006 inches to .012 inches.

e. Place a new gasket on the oil pan and install the pan on the cylinder block. Start all of the oil pan bolts before tightening them. Tighten the bolts snugly but not excessively, starting with the center bolts and working toward each end of the oil pan. Excessive tightening of the bolts will crush the oil pan gasket unnecessarily.

f. Refer to the current lubrication order and fill the oil pan.

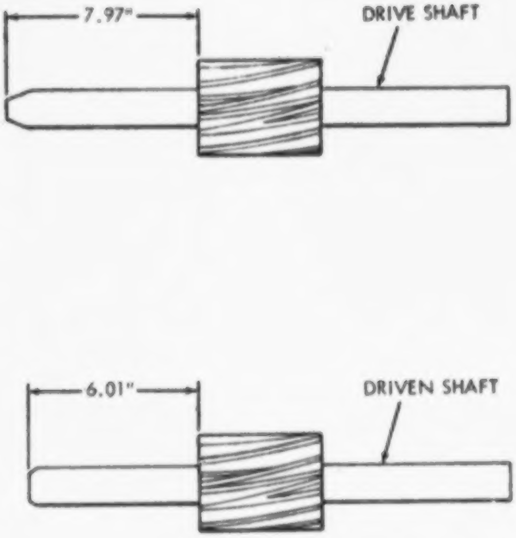

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Figure 3-35. Installing oil pump gear on shaft.

Section XI. CYLINDER HEAD ASSEMBLY

3-71. General

The cylinder head is a one-piece casting which can be removed from the engine as an assembly containing the cam followers and guides, push rods, rocker arms, exhaust valves, and fuel injectors. Provisions are made in the cylinder head for cooling and lubricating the attached sub-assemblies.

3-72. Removal

a. Disconnect exhaust piping at exhaust manifold.

b. Drain the cooling system.

c. Disconnect the fuel lines at the cylinder head.

d. Loosen the hose clamps and remove hose attached to the thermostat housing covers.

e. Loosen the hose clamps at each end of water bypass tube and remove tube.

f. Refer to TM 5-3805-240-12 and remove valve rocker cover.

g. Remove governor cover. Disconnect and remove the fuel rod between governor and injector control tube lever (para 3-29).

h. Loosen the fuel rod cover hose clamps. Slide hose up on the cover toward the governor.

i. Remove nuts (1, fig. 3-36) and exhaust manifold from studs (31).

j. Remove complete fuel injector assemblies, including control tube and brackets (para 3-174).

k. Remove cylinder head bolts (2) and stud nuts.

l. Lift head from cylinder block with lifting sling.

Caution: **Position wooden blocks on bench to support cylinder head and protect cam followers and spray tips from damage.**

m. Remove compression gaskets (4) and the oil and water seals (5, 6, 7, 8 and 9).

3-73. Disassembly

a. Place cylinder head on its side.

b. Remove bolts (1, fig. 3-37), lockwashers (2) and cam followers guides (3).

c. Remove cam follower assemblies (4).

d. Loosen locknut (7), unscrew push rod (5) from clevis (6).

e. Pull the push rod and spring assembly from bottom of clyinder head.

f. Disassemble locknut (7), upper spring (9), and lower spring seat (10) from push rod for cleaning and inspection. Remove retainers (11) only if defective or if head is to be replaced.

g. Place cylinder head upright on blocks. Place additional blocks beneath exhaust valves.

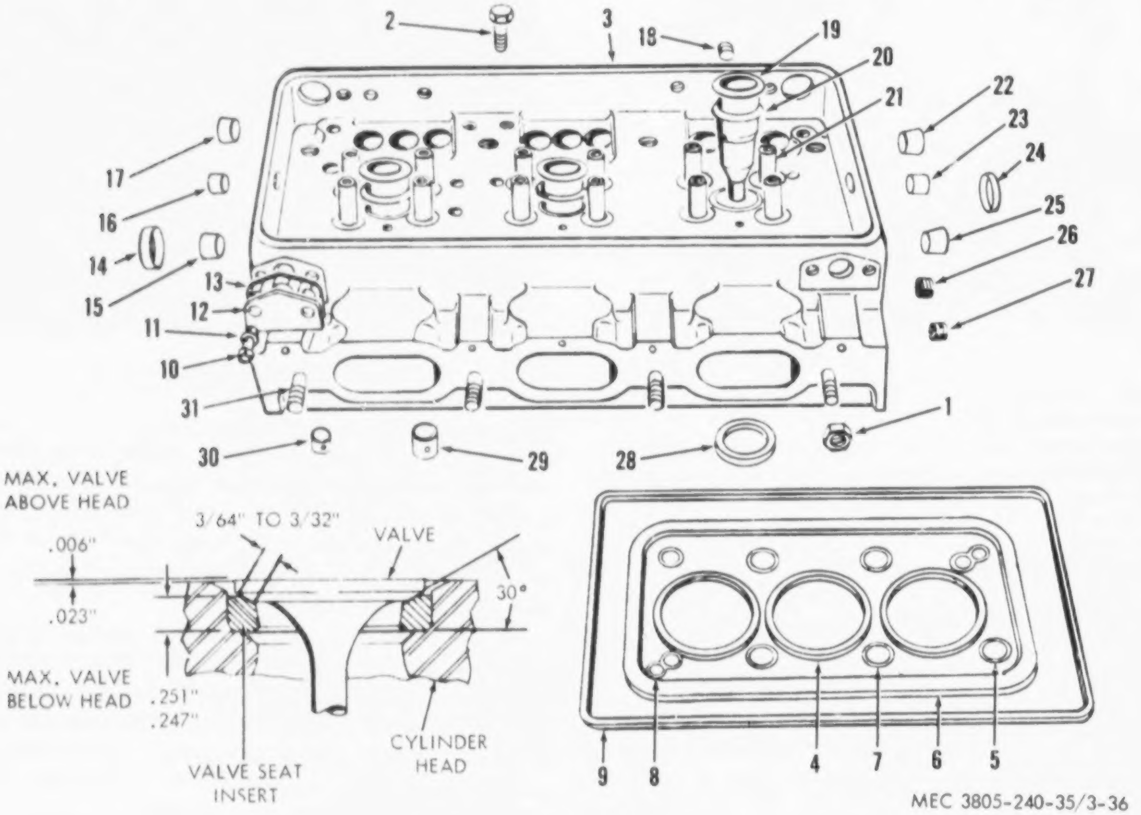
h. Remove rocker arms, brackets and shaft.

i. Remove exhaust valve bridge also (16, fig. 3-37 and 3-38).

j. Thread valve spring compressor adapter into the rocker shaft bolt hole cylinder head (fig. 3-39). Apply pressure to end of valve spring compressor handle to compress spring (10), (fig. 3-37). Remove lock halves (17).

k. Release tool and remove spring cap, (18), spring (19), and spring seat (20).

l. Do not remove valve bridge guides (21) unless defective. Remove by filing two 1/16 inch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MAX. VALVE ABOVE HEAD
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.023"
3/64" TO 3/32"
VALVE
30°
MAX. VALVE BELOW HEAD
.251"
.247"
VALVE SEAT INSERT
CYLINDER HEAD
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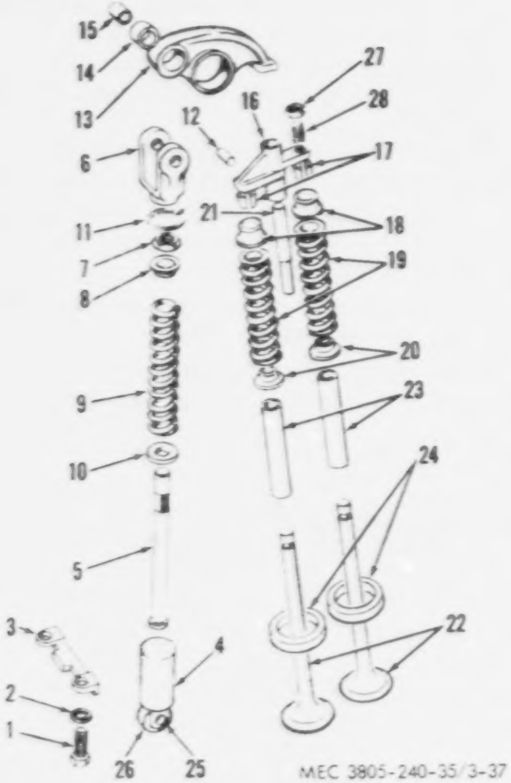
1	Nut (4 rqr)
2	Bolt (5 rqr)
3	Cylinder head
4	Compression Gasket (3 rqr)
5	Seal ring (3 rqr)
6	Gasket
7	Seal ring (3 rqr)
8	Seal ring (2 rqr)
9	Seal ring
10	Bolt (6 rqr)
11	Washer (6 rqr)
12	Cover (3 rqr)
13	Gasket (3 rqr)
14	Plug
15	Pipe plug
16	Plug
17	Plug
18	Pipe plug
19	Injector tube (3 rqr)
20	Ring (3 rqr)
21	Guide (12 rqr)
22	Plug
23	Plug
24	Plug
25	Plug
26	Plug
27	Pipe plug
28	Valve insert (3 rqr)
29	Nozzle
30	Nozzle
31	Stud (4 rqr)

Figure 3-36. Cylinder head, exploded view.



1	Bolt (2 rqr)
2	Lockwasher (2 rqr)
3	Cam follower guide
4	Cam follower
5	Push rod
6	Clevis
7	Locknut
8	Upper spring seat
9	Spring
10	Lower spring seat
11	Retainer
12	Pin
13	Rocker arm
14	Bushing
15	Bushing
16	Valve bridge
17	Lock (halves) (4 rqr)
18	Spring cap (2 rqr)
19	Spring (2 rqr)
20	Spring seat (2 rqr)
21	Bridge guide
22	Valve (2 rqr)
23	Valve guide (2 rqr)
24	Insert seat (2 rqr)
25	Pin
26	Roller set
27	Locknut
28	Adjusting screw

Figure 3-37. Exhaust valve operating mechanism exploded view.

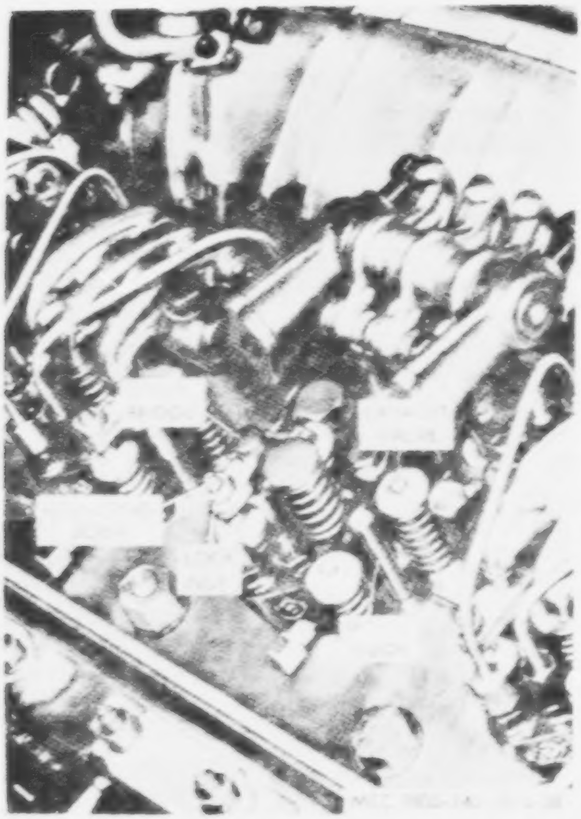


Figure 3-38. Exhaust valve and bridge.

deep notches in side of guide, about 1 1/2 inches from top. Place spacer over the guide. Slide guide remover over guide and align setscrews with the notches in the guide. Tighten the setscrews. Place long spacer over the guide remover. Thread nut on the guide remover and turn clockwise to remove guide (fig. 3-40).

m. To remove a broken valve bridge guide, drill hole 1/2 inch deep in end of guide with No. 3 drill. Tap with 1/4-20NF bottoming tap. Thread remover into guide and attach slide hammer. One or two blows with puller weight should remove guide (fig. 3-41).

n. Place cylinder head on its side.

o. Remove exhaust valves (22, fig 3-37) from bottom of head, numbering them for easier reinstallation.

p. Further disassembly is not required unless during cleaning and inspection procedure parts are shown to be not usable. These steps are outlined in paragraphs 3-74 and 3-75 below.

3-74. Cleaning

a. Steam clean the cylinder head.

b. If heavy scale deposits are noticed, remove injector tubes and water nozzles if not previous-

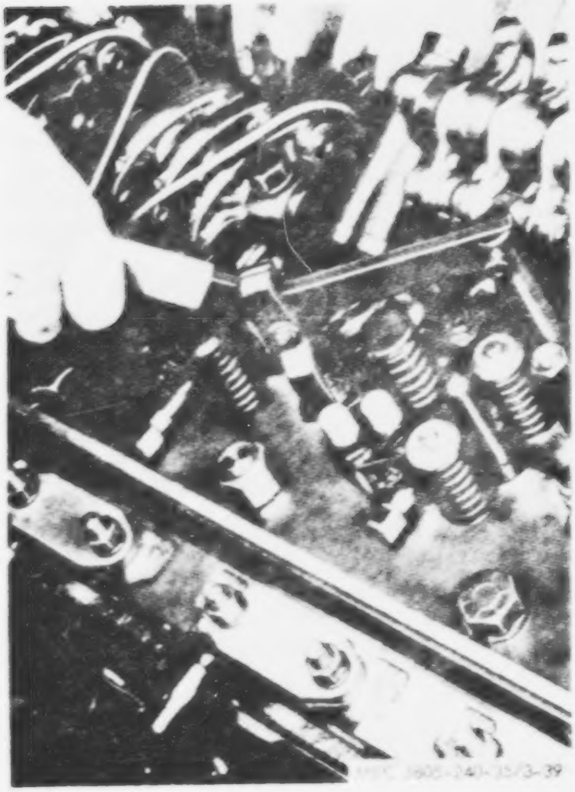


Figure 3-39. Valve spring compression.

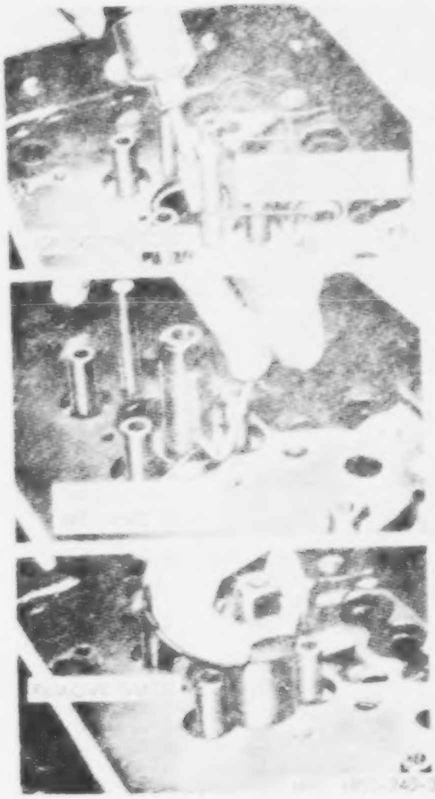


Figure 3-40. Valve bridge guide removal.

ly removed. Remove deposits by soaking in inhibited commercial pickling acid for 30 minutes. Drain block, reimmerse in acid for 10 minutes. Repeat if required. Rinse head in clear, hot water. Immerse head in alkaline bath to neutralize any acid remaining. Steam clean head. Dry with compressed air.

c. Remove any rustproofing compound by immersing head in solvent. Pass soft brush through openings. Dry with compressed air.

3-75. Inspection and Repair

a. Inspect cylinder head for leaks.

(1) Seal water holes in head with steel plates and suitable rubber gaskets clamped through head.

(2) Install scrap or dummy fuel injectors and tubes into head. Tighten clamp bolts to 20-25 foot-pounds torque.

(3) Drill and tap an opening in one of the steel plates for air hose connection.

(4) Apply 80-100 PSI air pressure to water jacket.

(5) Immerse head in water tank, previously heated to 180° (-200°—93.33° C) for 20 minutes.

(6) Inspect for any bubbles in water indicating cracks or leaks.

(7) Relieve air pressure, remove head from tank.

(8) Remove steel plates and parts, and dummy injectors.

(9) Dry head with compressed air.

(10) If cracks were shown in inspection, discard and replace cylinder head.

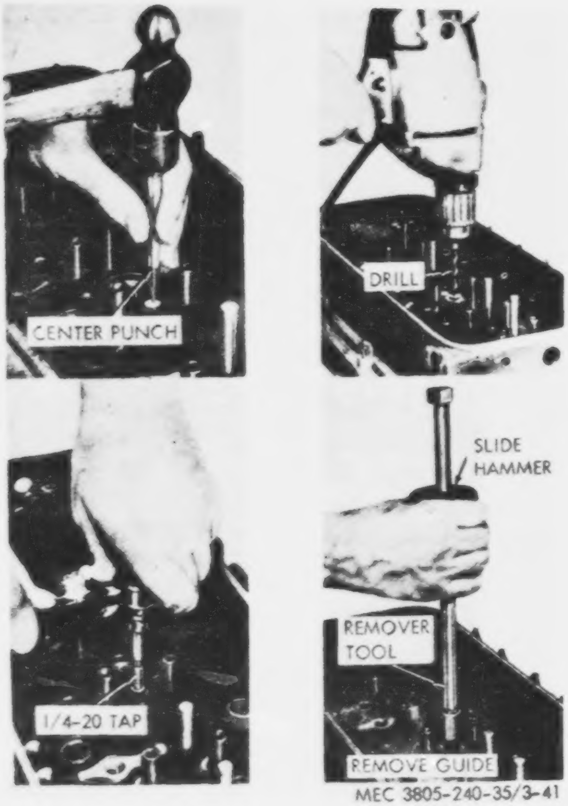
(11) Replace any leaking injector tubes (para 3-173).

b. Inspect bottom of cylinder head for flatness.

(1) Use straight edge and feeler gage. Check for warpage at each end and between cylinders (5 checkpoints). Maximum allowable warpage is 0.004 inch.

(2) Using same equipment, check flatness lengthwise on head at 6 points, below, above and through exhaust valve openings and at each end. Maximum allowable warpage is 0.0055 inch.

(3) If warpage is beyond allowable limits, cylinder head may be refaced if removal of a



MEC 3805-240-35/3-41

Figure 3-41. Broken valve bridge guide removal.

maximum of 0.020 inch will not reduce distance between bottom and top deck of head to less than 3.536 inches.

(4) If refacing is required, remove injector tubes, reface, install new tubes in head (para 3-173) and pressure check.

c. Inspect cam follower bores for wear or scoring. Remove light score marks with crocus cloth. If bores are excessively worn or scored, replace cylinder head. The cam follower-to-head clearance must range between 0.001—0.006 inch.

d. Clean cam follower assemblies with fuel oil. Dry with compressed air. Check that rollers turn smoothly and freely. If rollers are scored or have flat spots, check camshaft for defects. If excessively worn or damaged, camshaft must be replaced. Check rollers for allowable clearances (table 1-1). If rollers require replacement, see paragraph 3-76 *g*. for removal and reassembly. Inspect push rods for wear or distortion. Replace as required.

e. Inspect exhaust valves, inserts and guides.

(1) Clean the carbon from the valve stems and wash valves with fuel oil. If valve heads are warped or deeply pitted, or if stems are badly scratched or scuffed, replace the valves.

(2) If valve-to-guide clearance exceeds 0.005 inch, replace the valve guides.

(3) Clean the inside of the valve guides with brush to remove gum and carbon deposits. Inspect for defects or excessive wear (table 1-1).

(4) If guide must be removed, support head, bottom side up, and drive guide out from the bottom with valve guide remover.

(5) Inspect valve inserts for excessive wear or defects. The seating face should be at a 30° angle. If grinding does not bring insert to allowable limits, it must be replaced.

(6) If necessary, remove exhaust valve seat inserts as follows: (fig. 3-42).

(*a*) Place collet of valve seat insert remover inside the insert so bottom of collet is flush with insert bottom.

(*b*) Hold collet handle and turn the T handle to expand collet cone to secure insert.

(*c*) Insert drive bar of tool through the valve guide and tap bar to move insert about 1/10 inch.

(*d*) Turn T handle to loosen collet and move tool into the insert slightly so the narrow flange at the bottom of the collet is below the insert.

(*e*) Tighten cone and continue to drive insert out of cylinder head.

(7) Grinding of exhaust valve and valve seat inserts.

(*a*) Use valve seat grinder and eccentric valve seat grinder set.

(*b*) Refer to figure 3-36 continually for allowable limits.

(*c*) Grind insert with the 30° and 60° grinding wheels as required to open the throat or narrow the width of the insert.

(*d*) When allowable dimensions are achieved, clean insert with fuel oil and dry with compressed air.

(*e*) Check concentricity of insert with dial gauge (fig. 3-43). Total runout in reading should not exceed 0.002 inch. Check valve guide for possible bend if runout exceeds this amount. Replace as required.

(*f*) When grinding of insert is complete, use Prussian blue paste on insert to check contact area of valve on insert.

f. Inspect and check springs. Clean with fuel oil. See table 1-1 for allowable limits on push rod spring and exhaust valve spring. Replace as required.

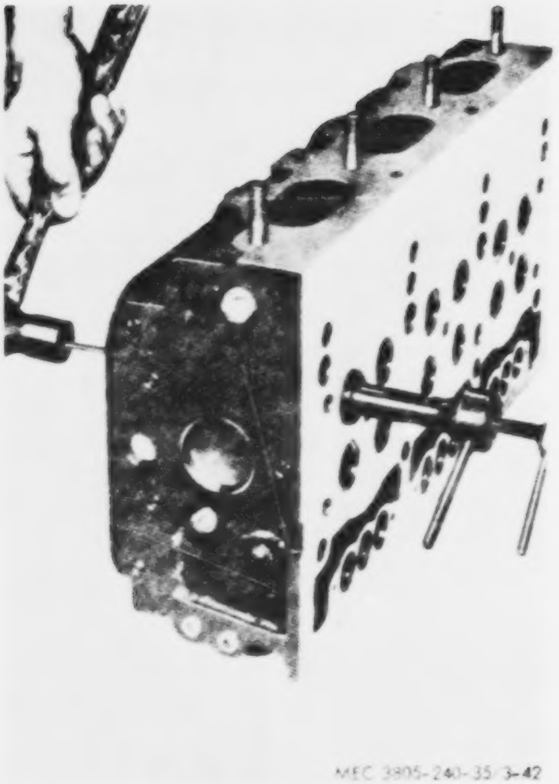

MEC 3805-240-35/3-42

Figure 3-42. Valve seat removal.

g. Inspect water nozzles for tightness of fit in head. Nozzles can be slightly enlarged with wooden plug to compensate for minor water hole enlargement. Replace as required.

h. Inspect studs and bolts for damage. Replace as required.

i. Wash the rocker arms, shaft and bracket in fuel oil and dry with compressed air. Check shaft and bushings for allowable clearances (table 1-1). The rocker arm pallets may be refaced by grinding to a maximum depth of 0.010 inch.

***Caution:* Do not overheat the rocker arms while grinding.**

j. Inspect valve bridge, valve bridge guide for excessive wear or damage. Replace as required. See figures 3-40 and 3-41 for removal of valve bridge guide.

k. Inspect all nuts, screws and hardware items for damage or wear. Replace as required.

3-76. Reassembly

a. Replace any pipe plugs removed from head.

b. If exhaust valve seat (24, fig. 3-37) was removed, replace with new seat as follows:

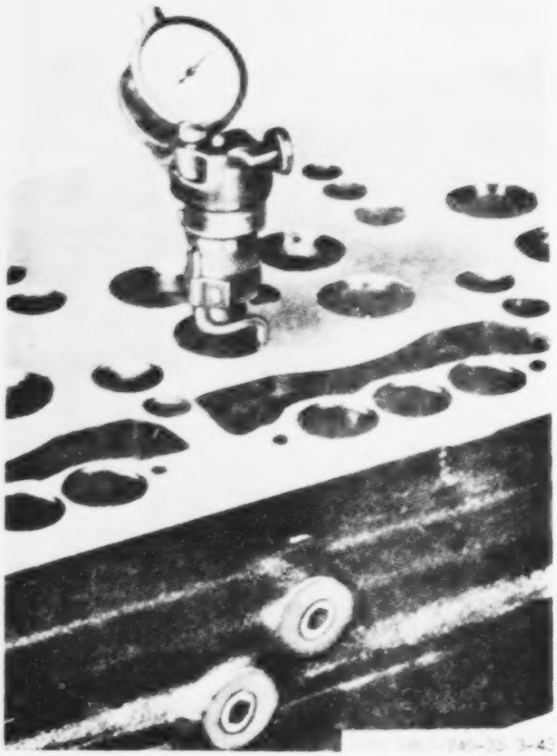

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Figure 3-43. Checking valve seat concentricity with dial gage.

(1) Clean the new seat insert and the counter-bore thoroughly with solvent.

(2) Check dimensions for allowable limits (table 1-1).

(3) Immerse cylinder head in water heated to 180°—200° F (82.22°—93.33°C) for 30 minutes.

(4) Place head, bottom side up, on bench and position insert in counterbore. Install, while head is still hot, with seat insert installer until it is solidly seated. Check concentricity.

c. If exhaust valve guides (23) were removed, replace with new guides carefully driving them in with valve guide installer.

d. If valve bridge guides (21) were removed, replace with new guides by starting guide in cylinder head, undercut end first. Place valve bridge guide installer over guide and drive into place.

e. If water nozzles (29 and 30, fig. 3-36) were removed, replace by pressing new nozzles into bottom of head. See figure 3-44 for proper installation angles of nozzle openings.

f. Install exhaust valves (22, fig. 3-37) as follows:

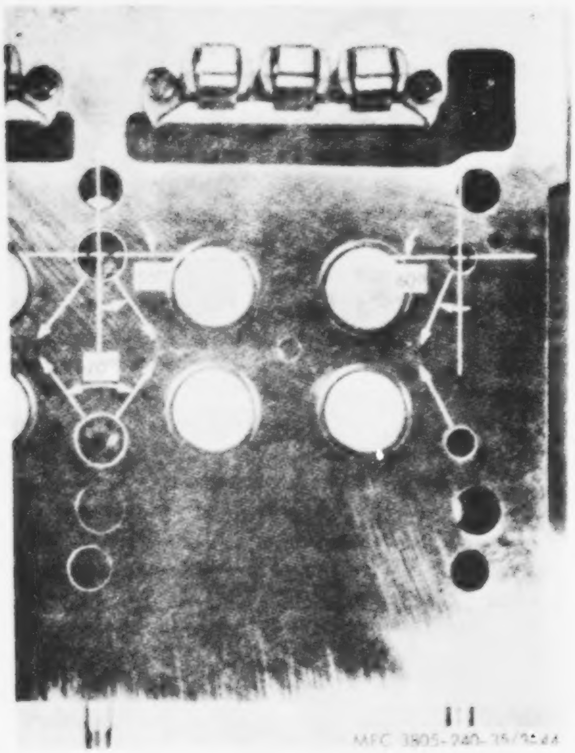
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Figure 3-44. Nozzle angles.

(1) Lubricate the valve stems and slide the exhaust valves into the valve guides (23).

(2) Hold valves in place with masking tape and turn right side up.

(3) Install spring seat (20) spring (19) and spring cap (18).

(4) Thread valve spring compressor adapter into rocker shaft bolt hole.

(5) Apply pressure to valve spring compressor handle and install lock halves (17). Release tool (fig. 3-39).

Caution: **Be sure none of valve heads protrude beyond limits (fig. 3-36).**

g. If cam follower assemblies (4, fig. 3-37) were defective, replace rollers and pins (26).

(1) Clamp cam follower service fixture in vise (fig. 3-45).

(2) Place cam follower in groove with pin resting on proper sized plunger.

(3) Use proper drift and drive pin from roller.

(4) Coat roller bushing and new pin with engine oil.

(5) Carefully drive new pin into place, centering in the legs of the follower. See table 1-1 for tolerances.

h. Install cam follower and push rod assembly into cylinder head.

(1) Assemble lower spring seat (10, fig. 3-37), push rod spring (9), upper spring seat (8), and locknut (7) on push rod (5).

(2) With retainer (11) in place in head, slide assembly into position from bottom of the cylinder head.

(3) Screw lock nut down on rod and then screw push rod into clevis (6).

(4) Lubricate cam follower assembly (4). Slide into position in bottom of head with oil hole in bottom of assembly away from exhaust valves.

(5) Install cam follower guide (3) with bolts (1) and lockwashers (2). Torque bolts to 12-15 foot-pounds.

i. Reassemble and install fuel injectors (para 3-182).

j. Install valve bride (16), adjustment screw (28), and locknut (27).

k. Reassemble and install rocker arms, shaft and brackets.

3-77. Installation

a. Replace all compression gaskets, oil and water seals.

b. Install guide studs in two corner cylinder head bolt holes in the block, diagonally opposite each other.

c. Using sling and hoist, position cylinder head above the block.

d. Make final check on gaskets and seals for proper positioning and lower head over the studs onto the cylinder block.

e. Apply SAE 30 engine oil to the cylinder head bolts, studs and nuts.

f. Install stud nuts and draw the head down lightly.

g. Remove guide studs. Install the cylinder head bolts.

h. Tighten the bolts and stud nuts lightly. Begin on cam follower side of head.

i. Tighten to 175-185 foot-pounds torque, one-half turn at a time. See figure 3-46 for sequence to be followed in tightening cylinder head bolts.

j. Adjust valve bridge (fig. 3-47).

(1) Place bridge in vise and loosen locknut on the adjusting screw.

(2) Install valve bridge on bridge guide.

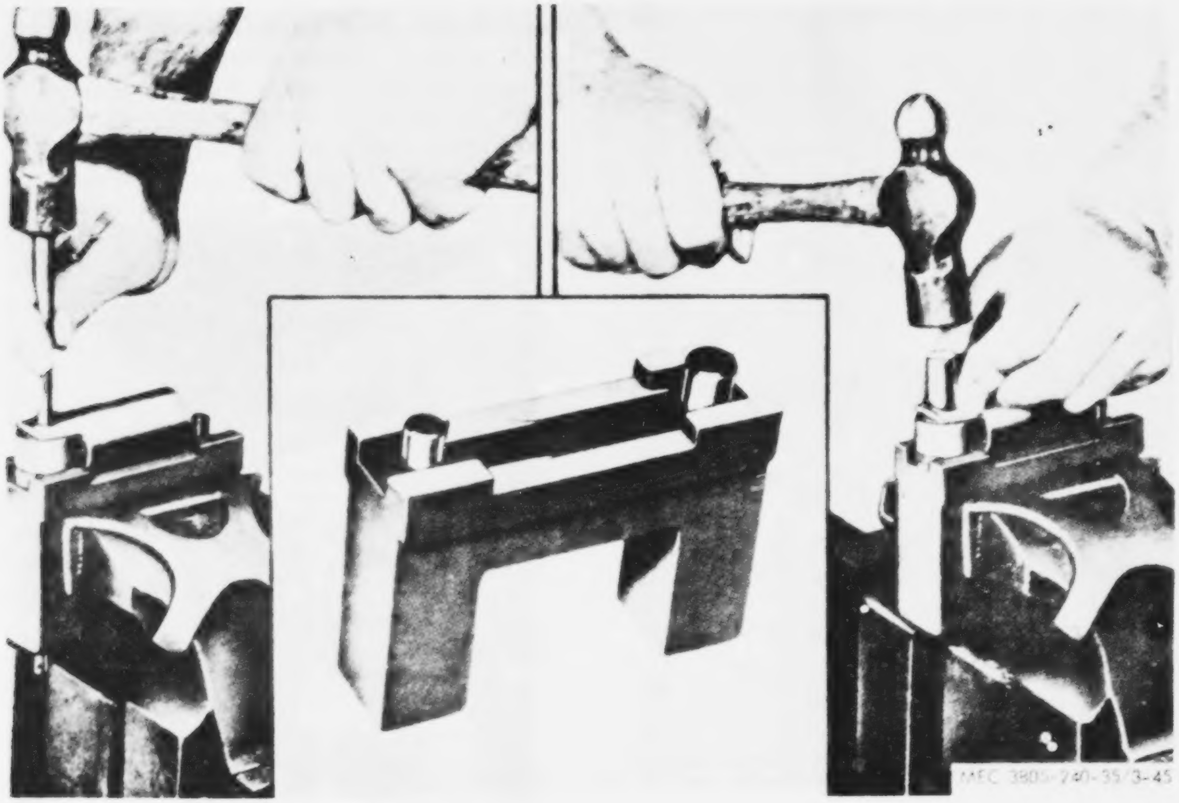


Figure 3-45. Removing and installing cam follower roller and pin.

(3) Press firmly down on bridge, turn the adjusting screw clockwise until it just touches the exhaust valve stem. Turn an additional 1/8 to 1/4 turn and tighten locknut finger tight.

(4) Remove valve bridge and place in vise. Hold adjusting screw with screwdriver and tighten locknut to 20-25 foot-pounds torque.

(5) Lubricate bridge and guide with engine oil.

(6) Reinstall the valve bridge.

(7) Place 0.0015 inch feeler gage stock under each end of bridge. Press firmly on bridge. If both 0.0015 inch feeler gages are not tight, repeat the adjustment.

(8) Adjust remaining valve bridges in the same way.

(9) Swing rocker arm assembly into position. Make sure valve bridges are properly positioned on rear valve stems. Tighten rocker arm shaft bracket bolts to 90-100 foot-pounds torque.

k. Reconnect fuel lines to the injectors and the fuel connectors. Use new washers in connectors. Tighten fuel pipe nuts to 12-15 foot-pounds torque.

l. Install fuel injector control tube assembly in place and tighten finger tight (para 3-174). Be sure ball end of levers engages slots in racks with return spring installed. Tighten bracket bolts to 10-12 foot-pounds torque.

m. Check that return spring pulls racks to out position after they have been in bottom position. Tap control tube lightly to correct most binding conditions.

n. Replace exhaust manifold Tighten stud nuts.

o. Replace clamps on fuel rod cover hose. Reposition hose and tighten clamps.

p. Replace and reconnect fuel rod between governor and injector control tube lever.

q. Tighten rocker arm bracket bolts to 90-100 foot-pounds torque.

r. Replace water bypass tube. Position and tighten hose clamps.

s. Replace hose to thermostat housing cover. Position and tighten hose clamps.

t. Reconnect fuel lines at cylinder head.

u. Reconnect exhaust pipe to exhaust manifold.

v. Fill the cooling system and check for leaks.

w. Check oil level at dipstick. Add oil if required.

x. Check that all parts function freely.

y. Adjust exhaust valve clearance and tune up engine (para 3-202).

z. Start engine and check for leaks.

aa. When engine warms up to 160° F (71.11° C), recheck torque on cylinder head bolts and nuts. Tighten to 175-185 foot-pounds torque.

ab. Recheck exhaust valve clearance and fuel injector timing.

ac. Install valve rocker cover and governor cover (para 3-33).

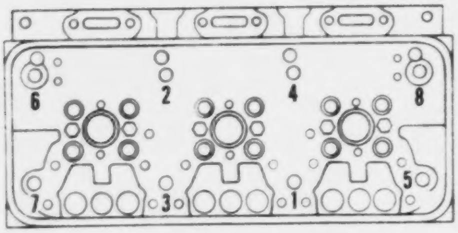


Figure 3-46. Cylinder head bolt tightening sequence.

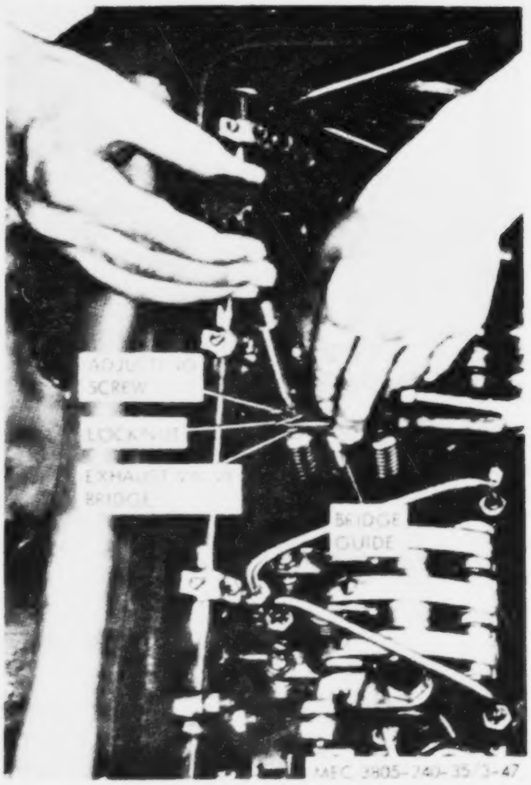


Figure 3-47. Valve bridge adjustment.

Section XII. ROCKER ARMS, BRACKETS AND SHAFTS

Refer to paragraph 3-73 for maintenance instructions.

Section XIII. CAM FOLLOWERS AND PUSH RODS

3-78. General

a. The rocker arms are operated by a camshaft through cam followers and short push rods extending through each cylinder head.

b. Contact between each cam follower and the camshaft is effected by a hardened roller incorporating a pressed-in bushing, which runs on a pin in the lower end of the cam follower.

c. Each cam follower operates in a bore in the cylinder head. A guide for each set of three cam followers is attached to the bottom of the cylinder head to keep the cam follower rollers in line with the cams and to serve as a retainer during assembly and disassembly of the cylinder head.

d. These parts are most easily removed and serviced with cylinder head removed from engine (para 3-72). However, an alternate method of removal and service without removal of cylinder head from engine is covered in this paragraph.

3-79. Removal

a. Refer to TM 5-3805-240-12 and remove the valve rocker cover.

b. Remove the fuel pipes from the injector and the fuel connectors.

c. Remove the rocker arm brackets and the rocker arm shaft (para 3-73).

d. Loosen the locknut (7, fig. 3-37) and unscrew the rocker arm (13) from the push rod (5) to be removed. Remove locknut.

e. Install push rod remover, a flat washer, and the locknut on the push rod, with the lower end of the tool resting on the upper spring seat (8).

f. Thread nut down on push rod to compress the push rod spring (9).

g. Remove the spring seat retainer (11) from cylinder head with a screwdriver (fig. 3-48).

h. Loosen locknut to release the spring. Then, remove the nut, flat washer and special remover from the push rod.

i. Pull the push rod (5, fig. 3-37), spring (9), spring seats (10 and 8) and cam follower (4) out through top of the cylinder head.

3-80. Disassembly

Refer to paragraph 3-76 and disassemble the cam follower assembly.

3-81. Cleaning

Refer to paragraph 3-75 and clean the cam followers and push rods.

3-82. Inspection and Repair

Refer to paragraph 3-75 and inspect and repair the cam followers and push rods.

3-83. Reassembly

Refer to paragraph 3-76 and reassemble the cam followers and push rods.

3-84. Installation

a. Lubricate cam follower assembly (4, fig. 3-37) by immersing in engine oil for five minutes.

b. Turn oil hole in bottom of cam follower away from exhaust valves and insert into cylinder head bore.

c. Assemble lower spring seat (10), spring (9), upper spring seat (8) and locknut (7) on the push rod (5).

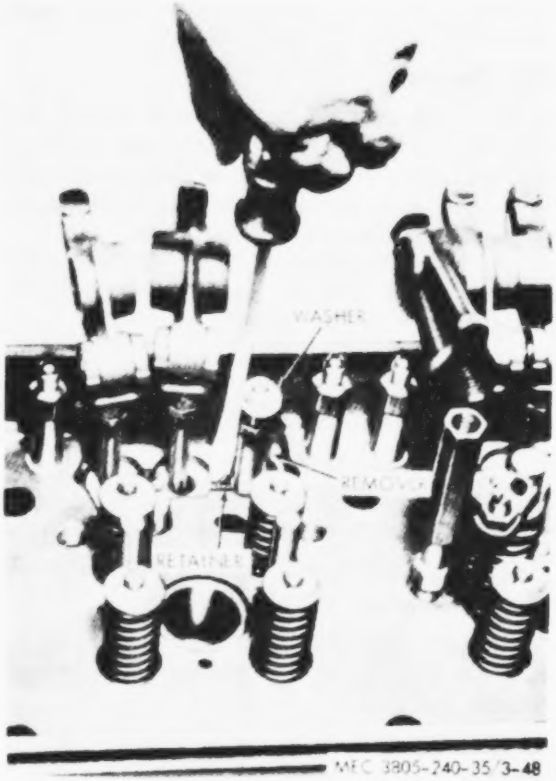


Figure 3-48. Spring seat retainer removal.

d. Install a flat washer and locknut on the push rod. Place push rod remover on the push rod between the washer and the upper spring seat. Screw nut down on push rod until spring is compressed to allow insertion of retainer (11) in head. Partially collapse the retainer and install it with the tangs facing the notch in the cylinder head.

e. Remove nut, flat washer and tool from the push rod.

f. Reinstall locknut on push rod as far as possible; then, screw the clevis (6) down on push rod until end of push rod is flush with inner side of clevis.

g. Replace rocker arms, shaft and bracket (para 3-76).

h. Replace fuel pipes on the fuel injector and reconnect fuel lines.

i. Refer to TM 5-3805-240-12 and replace the valve rocker cover.

Section XIV. VALVE SPRINGS, VALVE GUIDES AND VALVE SEATS

3-85. General

a. It is not possible to remove or service exhaust valves, valve guides and valve seats without removing the cylinder head from the engine (para 3-73). The valve springs are also normally removed when the head is off the engine.

b. An alternate method of removing and servicing the springs without removing the cylinder head is covered in this section.

3-86. Removal

a. Refer to TM 5-3804-240-12 and remove the rocker cover.

b. Rotate crankshaft clockwise to bring valve and injector rocker arms in line horizontally.

c. Disconnect and remove fuel pipes from the injectors and fuel connectors.

d. Remove the two bolts holding the rocker arm shaft brackets to the cylinder head. Remove brackets and shaft.

e. Remove the exhaust valve bridge (16, fig. 3-37).

f. Remove the cylinder block air box cover so piston travel may be observed. Turn crankshaft until piston is at the top of its stroke.

g. See paragraph 3-73 for final removal instructions.

3-87. Disassembly

Refer to paragraph 3-73 for disassembly instructions.

3-88. Cleaning

Refer to paragraph 3-74 and clean all parts.

3-89. Inspection and Repair

Refer to paragraph 3-75 and inspect and repair parts.

3-90. Reassembly

Refer to paragraph 3-76 for reassembly instructions.

3-91. Installation

a. Replace the exhaust valve bridge (16, fig. 3-37).

b. Reinstall rocker arm shaft and brackets. Replace bolts and tighten to proper torque specification (para 1-4).

c. Refer to TM 5-3805-240-12 and replace the rocker cover.

Section XV. PISTONS, PISTON RINGS AND PISTON PINS

3-92. General

a. The top of the piston forms the combustion chamber bowl and is designed to compress the air into close proximity to the fuel spray. The piston is cooled by a spray of lubricating oil directed at the underside of the piston head from a nozzle in the top of the connecting rod, by fresh air from the blower to the top of the piston, and indirectly by the water jacket around the cylinder. Each piston is fitted with compression rings and oil control rings. Eight equally spaced drilled holes just below each oil control ring groove permit excess oil, scraped from the cylinder walls, to return to the crankcase.

b. When an engine is hard to start, runs rough, or lacks power, worn or sticking compression rings may be the cause. Replacing these rings will aid in restoring engine operation to normal. The compression rings may be inspected through the ports in the cylinder liners after the air box covers have been removed. If the rings are free and are not worn to a point where the plating or grooves are gone, the compression should be within operating specifications.

c. Cylinder compression can be tested as follows:

(1) Refer to TM 5-3805-240-12 and remove the rocker covers.

(2) Start the engine and warm it up to normal operating temperature.

(3) Stop the engine and remove the fuel pipes and fuel injector at the number one cylinder (fig. 3-119 for cylinder firing order).

(4) Install one fuel pipe between the fuel inlet manifold connection and the fuel return manifold connection. This pipe will act as a jumper, permitting fuel from the inlet manifold to flow directly to the return manifold.

(5) Install a compression testing adaptor in place of the injector at the cylinder under test.

Connect a 0–600 PSI pressure gage to the adaptor.

(6) Start the engine and operate it at 600 RPM. Record the pressure reading on the gage.

Note. Do not attempt to obtain compression readings by cranking the engine with the starter motor.

(7) Check the compression at each cylinder as in steps (3), (4), (5) and (6), following the firing order. The compression pressure at each cylinder should not be less than 425 PSI (at sea level), and the variation in compression pressures between cylinders should not exceed 25 PSI. Table 1–2 gives minimum cylinder compression pressures at various altitudes (engine operating at 600 RPM). If the pressure at any cylinder is low, or if any cylinder has a compression variation of more than 25 PSI, check for the following defects:

(*a*) Broken, worn or sticking piston rings. (Check by removing the air box covers and pressing the compression rings with a blunt tool. A broken or sticking ring will not have a spring-like action.)

(*b*) Broken cylinder head gaskets.

(*c*) Defective exhaust valve seats.

(*d*) Defective piston heads.

3–93. Removal

a. Drain the engine lubricating and cooling systems.

b. Remove the cylinder head and oil pan. See paragraph 3–73 for cylinder head removal instructions.

c. Cover the piston head with a cloth and remove the carbon deposits from the upper inner surface of the cylinder liner (27, fig. 3–49).

d. Use a ridge cutter to remove any ridge in the cylinder liner at the top of the piston ring travel.

Note. Move the piston to the bottom of its travel and place a cloth over the top of the piston to collect the cuttings. After the ridge has been removed, turn the crank-shaft to bring the piston to the top of its stroke and carefully remove the cloth with the cuttings.

e. Remove the bearing cap (3) and lower bearing shell (4) from the connecting rod. Then, push the piston and rod assembly out through the top of the cylinder block. The piston cannot be removed from the bottom of the cylinder block.

f. With the connecting rod and piston removed from the cylinder block, reassemble the bearing cap (3) and lower bearing shell (4) to the connecting rod (5).

3–94. Disassembly

a. Disassemble the piston in the numerical sequence as illustrated on figure 3–49.

b. Secure the connecting rod in a vise equipped with soft jaws and remove the piston rings (7, 8, 9, 10, 11, 12, 13, 14, 15, and 16) with a piston ring removal tool. Discard the piston rings.

c. Punch a hole through the center of one of the piston pin retainers (17 and 20) with a narrow chisel or punch and pry the retainer from the piston. Use care to prevent damage to the piston and bushings.

d. Drive the remaining piston pin retainer (17 and 20) out from the inside with a brass rod or other suitable tool.

3–95. Cleaning

a. Clean all parts with fuel oil and dry them with compressed air. If the fuel oil does not remove carbon deposits, use a chemcial solvent which will not harm the piston pin bushings or the tin plate on the piston.

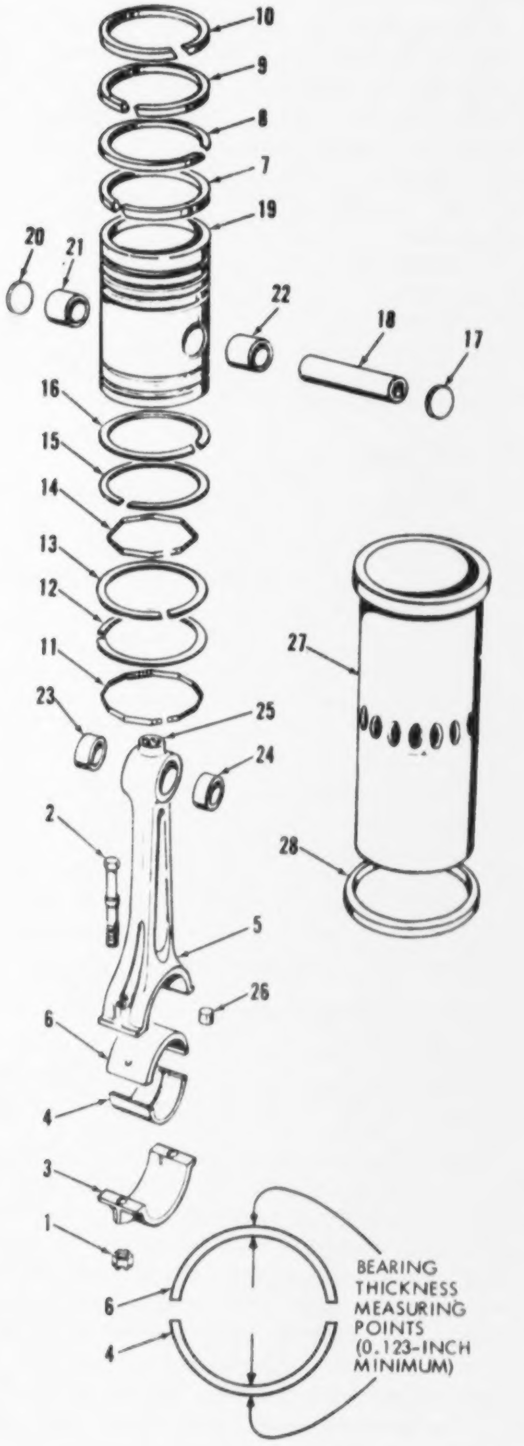
b. The upper part of the piston, including the compression ring lands and grooves, is not tin plated and may be wire-brushed to remove any hard carbon. However, care must be taken to avoid damaging the tin plating on the piston skirt. Clean the ring grooves with a piece of used compression ring that has been ground to a bevel edge or another suitable tool.

c. Clean the inside surfaces of the piston and the oil return holes in the lower half of the piston skirt. Exercise care to avoid enlarging the holes while cleaning them.

3–96. Inspection and Repair

a. Inspect the piston. If the tin plating on the piston and the original grooves in the piston rings are intact, it is an indication of very little wear.

Caution: **Excessively worn or scored pistons, rings and cylinder liners may be an indication of abnormal maintenance or operating conditions and these conditions should be corrected as soon as possible. Proper maintenance of the lubricating oil filter and air cleaner will reduce to a minimum the amount of abrasive dust and foreign material introduced into the cylinders and will, thereby, reduce the rate of wear. Long periods of operation at idle speed and the use of improper lubricating oil or fuel must be avoided, otherwise a heavy formation of carbon will result and cause the rings to stick. Keep the lubricating oil and engine coolant at the proper levels to prevent overheating the engine.**



MEC 3805-240-35/3-49

Figure 3-49. Connecting rod and piston assemblies, exploded view.

1	Nut (2 rqr)
2	Bolt (2 rqr)
3	Bearing cap
4	Lower bearing shell
5	Connecting rod
6	Upper bearing shell
7	Compression ring
8	Compression ring
9	Compression ring
10	Compression ring
11	Expander
12	Oil control ring, lower half
13	Oil control ring, upper half
14	Expander
15	Oil control ring, lower half
16	Oil control ring, upper half
17	Retainer
18	Pin
19	Piston
20	Retainer
21	Bushing
22	Bushing
23	Bushing
24	Bushing
25	Nozzle
26	Orifice
27	Liner
28	Insert

Figure 3-49—Continued

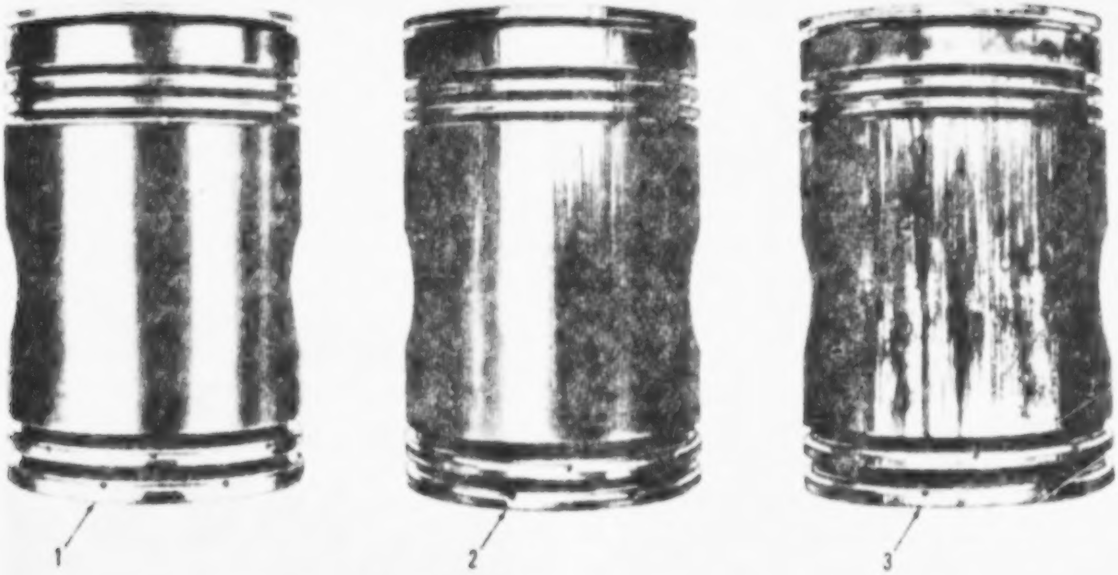
b. Examine the piston for score marks, cracks, damaged ring groove lands, or indications of overheating. A piston with light score marks which can be cleaned up may be reused (fig. 3-50). Any piston that has been severely scored, overheated, or burned must be replaced. Indications of overheating or burned spots on the piston may be the result of an obstruction in the connecting rod oil passage, which interrupted the flow of oil to the spray nozzle. Check the connecting rod as outlined in paragraph 3-103.

c. If cracks are found across the struts, inside of the piston, the piston must be replaced. The magnetic particle inspection methods outlined in paragraph 3-160 may be used in locating cracks in the piston.

d. Check the cylinder liner and block bore for excessive out-of-round, taper, or high spots which could cause piston failure. Replace the cylinder liner if necessary. See paragraphs 3-107 for cylinder liner replacement instructions.

Note. Other factors that contribute to piston failure include oil leakage into air box. Oil pull-over from the air cleaner. Dribbling injectors, combustion blow-by and low oil pressure (dilution of the lubricating oil).

e. If the piston is to be reused, measure the piston pin bushings (21 and 22, fig. 3-49) and the piston pin (18). The inside diameter of a new bushing in the piston is 1.5025 to 1.5030



1. PISTON SUITABLE FOR INSTALLATION.
2. PISTON SLIGHTLY SCORED; REMOVE SCORE MARKS WITH CROCUS CLOTH OR HARD INDIA STONE BEFORE INSTALLING.
3. PISTON BADLY SCORED; UNFIT FOR USE.

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Figure 3-50. Used pistons compared.

inches and the outside diameter of a new piston is 1.4996 to 1.5000 inches. The piston pin-to-bushing clearance with new parts is 0.0025 to 0.0034 inch. A maximum clearance of 0.010 inch is allowable with worn parts. The piston pin bushings in the connecting rod are covered in paragraph 3-103. Replace the piston pin and bushings if wear exceeds the above limits, as follows:

(1) Place the piston in a V-shaped holding fixture. Make sure the bushing bore is in alinement with the hole in the base of the fixture.

(2) Drive the bushings out of the piston with a remover tool.

(3) Place a spacer in the hole in the holding fixture.

(4) Set the piston on the fixture so the spacer protrudes into the bushing bore.

(5) Insert an installer tool in a bushing. Then, position the bushing and installer over the lower bushing bore.

***Caution:* The bushing joint should be located toward the bottom of the piston.**

(6) Drive the bushing in until it bottoms on the spacer.

(7) Install the other bushing in the same manner.

(8) Clamp a piston bushing reaming fixture in a vise. Then, insert the guide bushing in the fixture and secure it with the setscrew.

(9) Place the piston in the fixture and insert the pilot end of the reamer, through the clamping bar, piston pin bushings, and into the guide bushing.

(10) With the piston, fixture and reamer in alinement, tighten the fixture wing nuts securely.

(11) Apply light cutting oil to the reamer and ream the bushings. Turn the reamer in a clockwise direction only when reaming or withdrawing the reamer. For best results, use only moderate pressure on the reamer.

(12) Withdraw the reamer and remove the piston from the fixture. Remove the chips with compressed air and measure the inside diameter of the bushings. The diameter must be 1.5025 to 1.5030 inches.

f. Piston Fitting.

(1) Measure the piston diameter and cylinder liner bore, preferably at room temperature

(70° F) (21.11° C). The cylinder liner measurements are covered in paragraph 3-110.

(2) The piston skirt diameter must be measured lengthwise and crosswise of the piston pin bore. The taper and out-of-round, measured from a point approximately 1.88 inches from the top of the piston to the bottom of the piston, must not exceed 0.0005 inch.

(3) A new cylinder liner has an inside diameter of 4.2495 to 4.2511 inches throughout the entire length. Therefore, with new parts, the piston-to-liner clearance will vary with the particular piston diameter. A maximum clearance of 0.012 inch is allowable with used parts.

(4) Hold the piston upside down in the cylinder liner and check the piston-to-liner clearance (fig. 3-51). To avoid inaccurate readings, the liner must be in place in the cylinder block. Check the clearance in four places, 90 degrees apart.

(5) A spring scale, attached to the appropriate feeler gage, is used to measure the amount of force in pounds required to withdraw the feeler gage from between the piston and liner. Select a feeler gage with a thickness that will require a pull of six pounds to remove. The piston to-liner clearance will be 0.001 inch greater than the thickness of the feeler gage use, i.e. a 0.004 inch feeler gage will indicate a 0.005 inch clearance when it is withdrawn wtih a six pound pull. The feeler gage must be perfectly flat, and free of nicks and bends.

***Caution:* If any bind occurs between the piston and liner, remove the piston and examine the piston and liner for burrs. Remove burrs with a fine hone (a flat one is preferable) before proceeding with the clearance check.**

(6) If the piston or cylinder liner fail to meet the clearance specifications, replace the worn unit. See paragraph 3-107 for cylinder liner replacement instructions.

3-97. Reassembly

a. Reassemble the piston in reverse of numerical sequence as illustrated on figure 3-49.

b. Perform the connecting rod services detailed in paragraph 3-100.

c. Apply clean engine lubricating oil to the piston pin (18, fig. 3-49) and bushings (21 and 22).

d. Rest the piston in the piston holding fixture and place a new piston pin retainer (17 and 20) in position on the piston. Place the crowned end of a piston pin retainer installer tool, against the retainer and strike the tool just hard enough to deflect the retainer and seat it evenly in the piston.

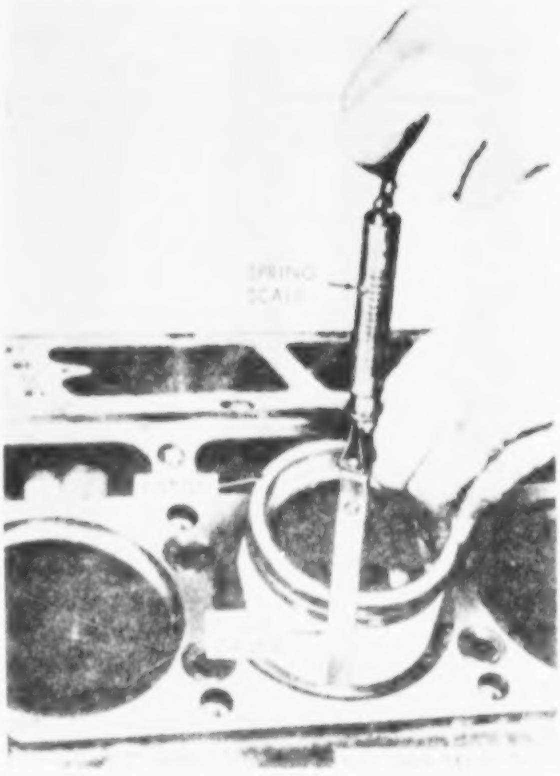

Figure 3-51. Piston to liner clearance measurement.

***Caution:* Do not drive the retainer in too far or the piston pin bushing may be moved inward and result in reduced piston pin end clearance.**

e. Place the upper-end of the connecting rod (5) between the piston pin bosses and in line with the piston pin holes. Then, slide the piston pin (18) in place. If the piston pin-to-bushing clearances are within the specified limits, the pin will slip into place without the use of force.

f. Install the second piston pin retainer as outlined in steps *d* and *e*.

g. After the piston pin retainers have been installed, check for piston pin end clearance by "cocking" the connecting rod on the pin and shifting it in its bushings.

h. One important function of the piston pin retainer is to prevent the oil, which cools the underside of the piston and lubricates the piston pin bushings, from reaching the cylinder wall.

Check the retainers for proper sealing as follows:

(1) Place the piston and connecting rod assembly upside down on a bench.

(2) Pour clean fuel oil in the piston to a level above the piston pin bosses.

(3) Dry the external surfaces of the piston in the area around the retainers, and allow the fuel oil to set for about fifteen minutes.

(4) Check for seepage of fuel oil around the retainers. If the fuel oil leaks around the retainers, install new retainers. In extreme cases, it may be necessary to replace the piston.

(5) After the leakage test is completed, empty the fuel oil from the piston, dry the parts with compressed air, and lubricate the piston pin with clean engine oil.

i. All new piston rings must be installed whenever a piston is removed, regardless of whether a new or used piston or cylinder liner is installed. Insert one ring at a time inside of the cylinder liner and far enough down in the bore to be within the normal area of the ring travel. Use a piston to push the ring down to be sure it is parallel with the top of the liner. Then, measure the ring gap with a feeler gage as shown in figure 3-52. The ring gaps are specified in the limits and clearance chart, table 1-1.

j. If the ring gap is insufficient, it may be increased by filing or stoning the ends of the ring. File or stone both ends of the ring so the cutting action is from the outer surface to the inner surface. This will prevent any chipping or peeling of the chrome plate on the compression ring. The ends of the ring must remain square and the chamfer on the outer edge must be approximately 0.015 inch

k. Check the ring clearance in the piston ring grooves, as illustrated in figure 3-53. The piston ring clearances are indicated in table 1-1.

l. Refer to figure 3-49 for the location and method of installing the rings on the piston. Install the compression rings on the piston with the same tool used for piston ring removal. To avoid breaking or over stressing the rings, do not spread them any more than necessary to slip them over the piston.

***Caution:* The upper compression (fire) ring has a tapered face and must be installed with the face marked "T" or "TOP" facing up.**

m. Install the oil control rings by hand. The scraping edges must face toward the bottom of the piston for proper oil control. First, install the expander carefully in the upper oil ring groove. Next, install the top ring with the gap 180 degrees from the gap in the expander. Then, install the bottom ring with the gap 45 degrees from the gap of the upper ring. Install the oil control rings and expander in the lower oil ring groove in the same manner.

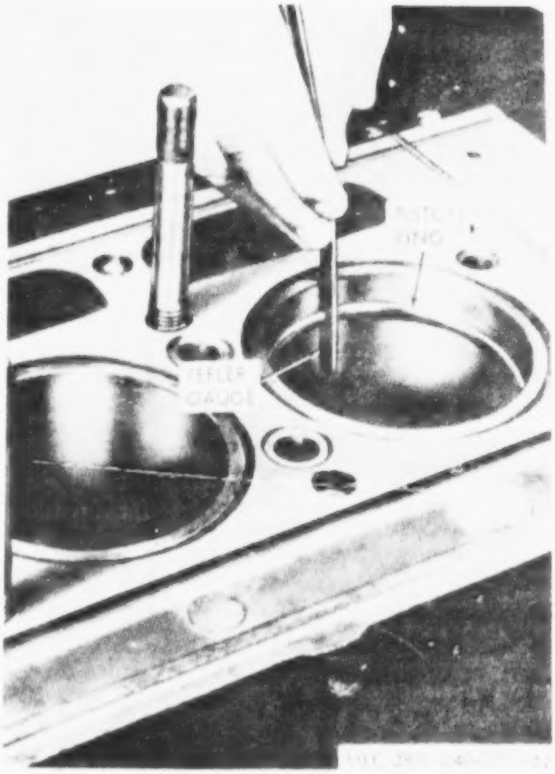

Figure 3-52. Piston ring gap measurement.

n. When installing the oil control rings, care must be exercised to prevent overlapping the ends of the oil control ring expanders. The expanders must be correctly seated inside the piston oil control ring grooves. An overlapped expander will cause the oil control ring to protrude beyond allowable limits. A protruding oil control ring will be broken when the piston is installed in a ring compressor or when the piston and rod assembly is installed in the cylinder liner.

3-98. Installation

***Caution:* Used cylinder liners must be honed to remove surface glaze before pistons are installed. See paragraph 3-109 for cylinder liner honing instructions.**

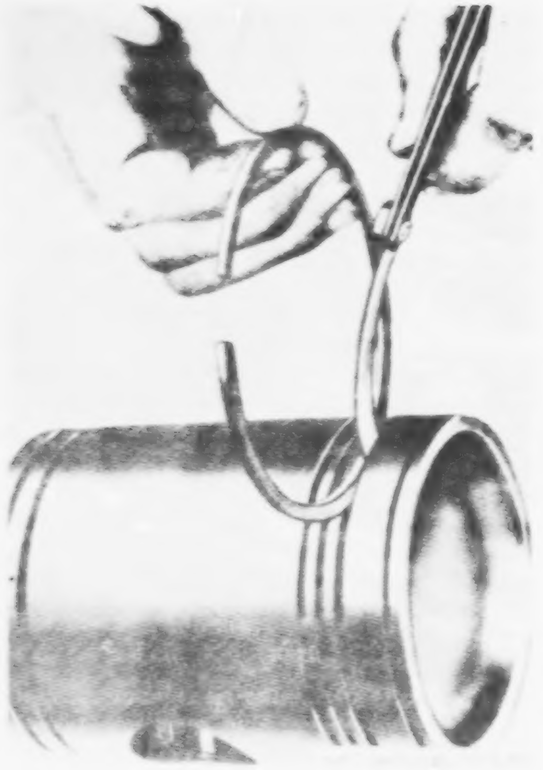

Figure 3-53. Piston ring side clearance measurement.

a. Apply clean engine oil to the piston, rings and the inside surface of a piston ring compressor tool.

Caution: **Inspect the ring compressor for nicks or burrs, especially at the nontapered inside diameter end. Nicks or burrs on the inside diameter of the compressor will result in damage to the piston rings.**

b. Place the piston ring compressor on top of a wood block, with the chamfered end of the ring compressor facing up.

c. Position (stagger) the piston ring gaps properly on the piston. Make sure the ends of the oil control ring expanders are not overlapped.

d. Start the top of the piston straight into the ring compressor. Then, push the piston down until it contacts the wood block.

Note. The numbers on the side of the connecting rod and cap identify the rod with the cap and indicate the particular cylinders in which they are used. If a new connecting rod is to be installed. The same identification number must be stamped in the same location as on the connecting rod that was replaced.

e. Use hold-down clamps to retain any cylinder liners already in place on the engine block when the crankshaft is rotated.

f. Rotate the crankshaft until the connecting rod journal of the particular cylinder being worked on is at the bottom of its trevel. Wipe the crankshaft journal clean and lubricate it with clean engine oil.

g. Install the upper bearing shell (6, fig. 3-49)—the one without the continuous oil groove—in the connecting rod. Lubricate the bearing shell with clean engine oil.

h. Position the piston, connecting rod, and compressor tool assembly in front of the cylinder block so that the identification number and letter on the connecting rod face the outer edge of the cylinder block. Then carefully guide the bearing end of the connecting rod through the cylinder liner to avoid damaging the liner.

i. Push the piston and connecting rod assembly down into the cylinder liner until the piston is free of the ring compressor. Push or pull the piston into the liner until the upper bearing shell (6) is firmly seated on the crankshaft journal.

Caution: **Do not force the piston into the liner. The peripheral abutment type expanders apply considerable more force on the oil ring than the standard expander. Therefore, extra care during the loading operation must be taken to prevent ring breakage. If there is noticeable resistance during installation, check for overlapped oil control ring expander ends and correct the overlap. Do not cut or grind the oil ring expanders.**

Caution: **The distance from the vertical center line of the connecting rod bolts to the edges of the rod are not equal. Therefore, when installing the piston and connecting rod assembly, be sure that the narrow side of the two connecting rods on the crankshaft journal are together to avoid cocking of the rod.**

j. Place the lower bearing shell (4)—the one with the continuous oil groove from one parting line to the other— in the connecting rod bearing cap (3), with the tang on the bearing shell in the notch in the bearing cap. Lubricate the bearing shell with clean engine oil.

k. Install the bearing shell (4) and cap (3) on the connecting rod (5) with the identification numbers adjacent to each other. Tighten the connecting rod nuts to 65-75 foot-pounds torque.

l. Check the connecting rod side clearance. The clearance between each pair of connecting rods should be 0.008 to 0.016 inch with new parts.

m. Install other piston and rod assemblies in the same manner. Use holddown clamps to hold each liner in place when rotating the crankshaft. After all of the liners and pistons have been installed, remove the holddown clamps.

n. Install the compression gaskets and water and oil seals and install the cylinder head (para 3-76) and any other parts which were removed from the engine.

o. After the engine has been completely reassembled, refer to the current lubrication order and refill the crankcase to the proper level on the dipstick.

p. If new parts such as pistons, rings, liners or bearings were installed, operate the engine on the run-in schedule given in paragraph 3-201 and table 3-1 to permit the mating parts to wear in properly before being subjected to full load operation. If available, it is preferable to use a dynamometer for the run-in.

Section XVI. CONNECTING RODS AND ROD BEARINGS

3-99. General

a. Each connecting rod is forged to an "I" section with a closed hub at the upper end and a bearing cap at the lower end. The connecting rod is drilled to provide lubrication to the piston pin at the upper end and is equipped with a nozzle to spray cooling oil on the underside of the piston head. An orifice is pressed into the counterbore at the lower end of the oil passage to meter the flow of oil. A helically-grooved bushing is pressed into each side of the connecting rod at the upper end. The cavity between the inner ends of these bushings registers with the drilled oil passage in the connecting rod and forms a duct around the piston pin. Oil entering this cavity lubricates the piston pin bushings and is also forced out of the spray nozzle to cool the piston. The piston pin floats in the bushings of both the piston and connecting rod.

b. The connecting rod bearing shells are of the replaceable precision type and consist of an upper shell carried in the connecting rod and a lower shell seated in the connecting rod cap. The bearing shells are located by and prevented from endwise and radial movement by a tang at the parting line at one end of each shell. The upper and lower connecting rod bearing shells are different. Therefore, they must not be interchanged. Both shells are notched midway between the bearing edges for approximately 3/4 of an inch in from each parting line. In addition, the lower shell has a circumferential oil groove that terminates at the notched end. These notches maintain a continuous registry with the oil holes in the crankshaft bearing journals, thereby providing a constant supply of lubricating oil to the connecting rod bearings, piston pin bushings and spray nozzle through the oil passage in the connecting rod.

c. Connecting rods should be inspected for damage or excessive bearing or bushing wear whenever piston and connecting rod assemblies are removed from the engine block.

3-100. Removal

Remove connecting rod and piston assembly (para 3-93).

3-101. Disassembly

a. Disassemble the connecting rod and piston assembly (para 3-94).

b. Remove the bushings from the connecting rod, as follows:

(1) Clamp the upper end of the connecting rod in a holder, so that the bore in the bushing (23 and 24, fig. 3-49) is alined with the hole in the base of the holder.

(2) Set the bushing remover tool in the connecting rod bushing, insert handle in the remover, and drive both bushings from the rod.

c. Remove the spray nozzle as follows:

(1) Remove the piston pin bushings from the connecting rod as described above.

(2) Insert a spray nozzle remover tool through the upper end of the connecting rod and insert the pin in the curved side of the remover into the opening in the bottom of the spray nozzle (25).

Note. The spring pin orifice (26) in the lower end of the drilled passage in the connecting rod is not serviced separately and need not be removed.

(3) Support the connecting rod and spray nozzle remover in an arbor press and place a short pipe sleeve directly over the spray nozzle. The internal diameter of the pipe sleeve must be slightly greater than the outer diameter of the spray nozzle. Press the nozzle from the connecting rod.

3-102. Cleaning

a. Clean the connecting rod and piston pin with fuel oil and dry them with compressed air.

b. Clean the bearing cap (3, fig. 3-49) and the bearing shells (4 and 6) with clean engine lubricating oil and wipe dry with a clean, soft cloth.

3-103. Inspection and Repair

a. If magnetic particle inspection equipment is available, check the connecting rod for cracks by the magnetic particle inspection method. See figure 3-54. Follow the instructions which accompany the equipment, observing the following rules:

(1) Remove the connecting rod bushings where practical before the inspection. Some fatigue cracks cannot be observed with bushings in place.

(2) Magnetic indications in the areas listed as noncritcial in figure 3-54 are acceptable, unless visual nonmagnetic inspection alone reveals them as obvious cracks.

(3) Longitudinal indications which follow forged flow lines are usually seams, and are not considered harmful if less than 0.03125 inch deep. Determine the depth of such indications by grinding a small area near the center of each indication.

(4) Transverse indications (across flow lines) which have a maximum length of 0.5 inch are acceptable *only* if they have a maximum depth of 0.015625 inch and *only* if they are completely removed by grinding. An exception to this is an indication which extends over the edge of the "H" section of the rod and is present on both sides of the flange. In this case, maximum permissible depth is 0.005 inch. See section A-A of figure 3-54.

(5) If fatigure indications are observed in the oil passage area of the bushing hole, discard the connecting rod. See section B-B, figure 3-54.

(6) Grind all indication areas to form smooth contours and blend the ground area into the unground area. See the grinding detail of figure 3-54.

(7) Replace any connecting rods which fail to meet the above crack limits.

Note. If the connecting rod is replaced, stamp the cylinder number on the new connecting rod and cap. Stamp the number in the same position and area it occupied on the old connecting rod.

b. Blow compressed air through the oil passage in the connecting rod to make certain it is not blocked. Check the spray nozzle to make certain the holes are open. If the spray nozzle is damaged or severely blocked, replace it as in paragraphs 3-101 and 3-104.

c. Inspect the connecting rod bushings (23 and 24, fig. 3-49) for indications of scoring, heating, or other damage.

Caution: **Connecting rod bushings which have overheated may become loose and creep together, blocking the supply of lubricating oil to the piston pin and spray nozzle.**

d. Measure the outside diameter of the piston pin (18) and measure the inside diameter of each bushing (23 and 24). If difference between the two measurements exceeds 0.010 inch, replace the pin and both bushings. Remove the connecting rod bushings (23 and 24) from the rod (5) as in paragraphs 3-101 and 3-104.

e. Inspect the bearing surface of both bearing shells (4 and 6) for scoring, pitting, flaking, etching and dirt grooving. If any of these defects are present, replace the bearing shells.

Note. The upper bearing shell, which carries most of the load, will normally show such signs before the lower bearing shell.

f. Inspect the back of each bearing shell for bright spots which indicate that it has moved in its support. Inspect the connecting rod (5) and cap (3) bearing seats for burrs and foreign particles. Replace bearing shells with bright spots and remove burrs or foreign particles from the connecting rod and cap.

Caution: **Use care to avoid deforming the bearing seats in the connecting rod and cap.**

g. Using a ball micrometer, or a micrometer with a ball attachment, measure the thickness of each bearing shell (4 and 6) at a point 90 degrees from the parting line. See figure 3-49. Replace bearing shells which have worn to a thickness of less than 0.123 inch.

h. Temporarily install the connecting rod bearing shells (4 and 6, fig. 3-49) in the connecting rod (5) and cap (3). See paragraph 3-104 for assembly instructions. Position the connecting rod in the engine block in the position in normally occupies, with the stamped number facing away from the camshaft and toward the outside of the block. Place a soft plastic measuring strip around the crankshaft journal and temporarily install the cap (3) and lower bearing shell (4). Torque the nuts (1) to 65-75 foot-pounds. Carefully remove the connecting rod assembly from the engine block and check the plastic strip. If the indicated clearance between the crankshaft

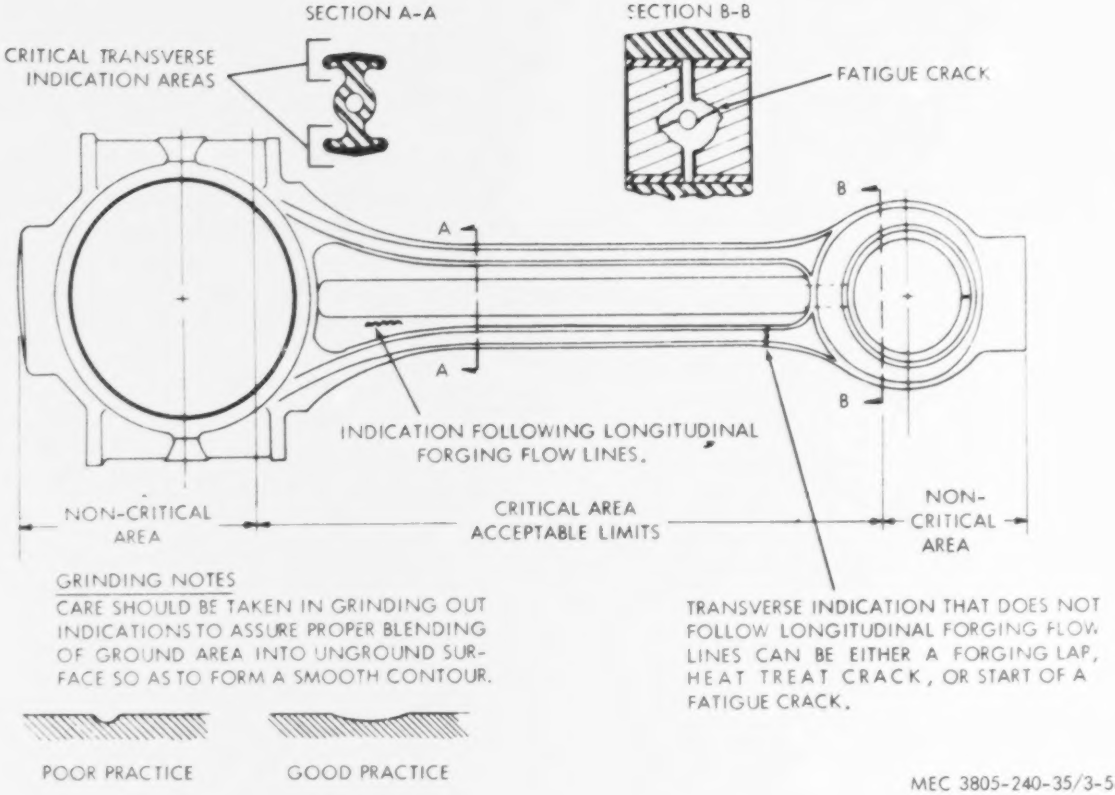
SECTION A-A
SECTION B-B
CRITICAL TRANSVERSE INDICATION AREAS
FATIGUE CRACK
A
A
B
B
INDICATION FOLLOWING LONGITUDINAL FORGING FLOW LINES.
NON-CRITICAL AREA
CRITICAL AREA ACCEPTABLE LIMITS
NON-CRITICAL AREA
GRINDING NOTES
CARE SHOULD BE TAKEN IN GRINDING OUT INDICATIONS TO ASSURE PROPER BLENDING OF GROUND AREA INTO UNGROUND SURFACE SO AS TO FORM A SMOOTH CONTOUR.
TRANSVERSE INDICATION THAT DOES NOT FOLLOW LONGITUDINAL FORGING FLOW LINES CAN BE EITHER A FORGING LAP, HEAT TREAT CRACK, OR START OF A FATIGUE CRACK.
POOR PRACTICE
GOOD PRACTICE
MEC 3805-240-35/3-54

Figure 3-54. Connecting rod magnetic particle inspection limits.

bearings and the crankshaft journal exceeds 0.006 inch, replace both bearing shells.

3-104. Reassembly

a. Install a new spray nozzle as follows:

(1) Start the spray nozzle, with the holes positioned as shown in figure 3-55, straight into the counterbore in the top of the connecting rod.

(2) Support the connecting rod in an arbor press. Then, place a short 3/8 inch ID sleeve on top of the spray nozzle and under the ram of the press.

(3) Press the spray nozzle into the connecting rod until it bottoms in the counterbore.

b. Install new bushings in the connecting rod as follows:

(1) Clamp the connecting rod in the connecting rod holder.

(2) Start one of the new bushings straight into the bore of the connecting rod.

Note. The bushing joint must be toward the top of the connecting rod.

(3) Insert the bushing installer in the bushing. Then, insert the handle in the installer and drive the bushing in until the flange of the installer bottoms on the connecting rod.

c. Service replacement bushings must be reamed to size in the following manner:

(1) Clamp the reaming fixture in a bench vise. Position the adapter sleeve on the arbor of the fixture.

(2) Place the large end of the connecting rod over the arbor of the fixture and tighten the connecting rod bolt nuts to 65-75 foot-pounds torque.

(3) Slide the forward guide bushing into the front guide boss with the pin end facing out.

(4) Aline the upper end of the connecting rod with the opening in the reaming fixture.

(5) Install the rear guide bushing on the reamer and insert the reamer and bushing through the rear guide boss of the fixture.

(6) Apply light cutting oil to the reamer and ream the bushings. Turn the reamer in a clockwise direction only, when reaming or withdrawing the reamer. For the best results, use only moderate pressure on the reamer.

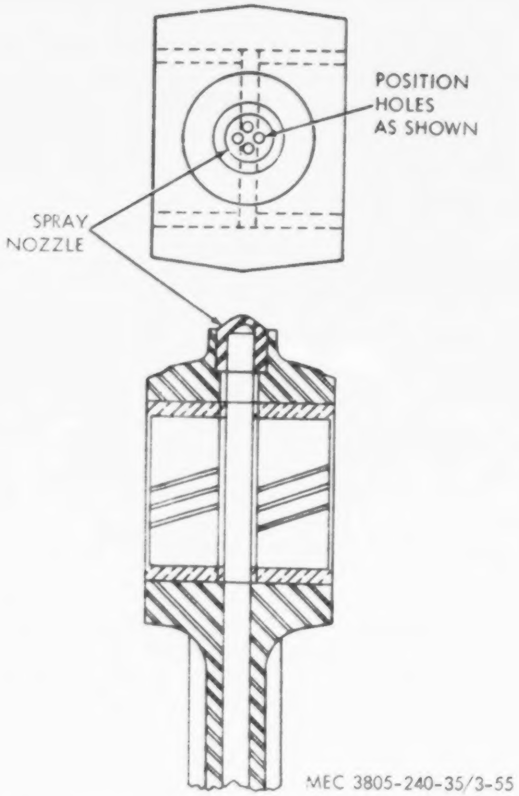

Figure 3-55. Spray nozzle location in connecting rod.

(7) Remove the reamer and the connecting rod from the fixture, blow out the chips and measure the inside diameter of the bushings. The inside diameter of the bushings must be 1.5015 to 1.5020 inches.

3-105. Installation

a. Reassemble the connecting rod and piston assemblies as described in paragraph 3-97.

b. Install the piston and connecting rod assemblies in the engine block. See paragraph 3-97 for piston and connecting rod installation instructions.

Section XVII. CYLINDER LINERS

3-106. General

The replaceable type cylinder liner is accurately machined and heat treated to provide a long wearing scuff-resistant surface. The flange at the top fits into a counterbore in the cylinder block and rests on a replaceable cast iron insert which permits accurate alinement of the cylinder liner. Compression is sealed with an individual laminated compression gasket for each cylinder.

3-107. Removal

a. Remove the piston and connecting rod assembly (para 3-93).

b. Refer to figure 3-56 and remove the cylinder liner as follows:

Caution: **It is very important that the proper method is followed when removing a liner. Do not attempt to push the liner out by inserting a bar in the liner ports and rotating the crankshaft, otherwise the piston may be damaged or the upper ring groove may collapse.**

(1) Ease the lower shoe and bolt assembly down into the liner. Place the shoe on the bottom edge of the liner with the flat on the shoe being parallel with the crankshaft bore.

(2) Hold the lower shoe and bolt assembly in the pulling position. Place the upper shoe with the flat in the same position as the lower shoe over the threaded end of the bolt. Thread the nut down on the bolt assembly and be sure that the pilots on both of the shoes are seated properly.

(3) Place the bridge assembly (open end down) over the upper shoe and down against the block.

(4) With the thrust bearing on the bolt, install the bolt through the bridge assembly strap hole.

(5) Thread the bolt into the female threaded portion of the bolt assembly.

(6) Turn the bolt in a clockwise direction and withdraw the liner from the block. Then, remove the tool from the liner.

(7) Remove the liner insert from the counterbore in the block.

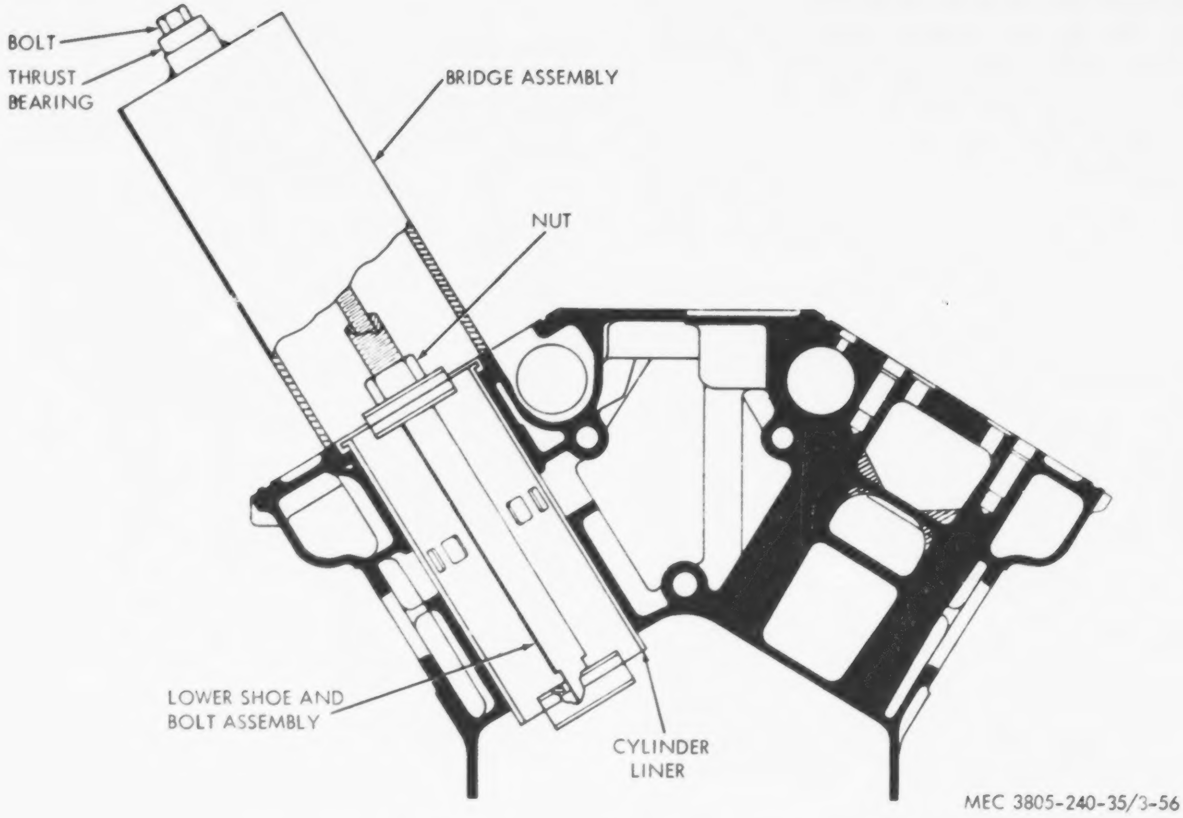

Figure 3-56. Cylinder liner removal.

3-108. Cleaning

Clean the cylinder liner and insert with an approved solvent and blow dry with compressed air.

3-109. Inspection and Repair

a. Inspect the cylinder liner for the following defects:

(1) Cracks.
(2) Scoring.
(3) Poor contact on outer surface.
(4) Flange irregularities.
(5) Inside diameter.
(6) Out-of-roundness.
(7) Taper.

b. A cracked or excessively scored liner must be discarded. A slightly scored liner may be cleaned up and reused.

c. Excessive liner-to-block clearance or block bore distortion will reduce heat transfer from the liner to the block and to the engine coolant. Poor contact between the liner and the block bore may be indicated by stains or low pressure areas on the outer surface of the liner.

d. Examine the outside diameter of the liner for fretting. Fretting is the result of a slight movement of the liner in the block bore during engine operation, which causes material from the block to adhere to the liner. These metal particles may be removed from the surface of the liner with a coarse, flat stone.

e. The liner flange must be smooth and flat on both the top and bottom surfaces. Check for cracks at the flange. The liner insert must also be smooth and flat on the top and bottom surfaces. Replace the insert if there is evidence of brinelling.

f. Inspect the block bore whenever a liner is removed. The specified clearance between the block bore and the liner is 0.000 to 0.002 inch (new parts). It may be necessary to hone the block bore oversize if it is distorted.

g. Measure the inside diameter of the liner at the various points indicated in figure 3-57. Use a cylinder liner bore gage which has a dial indicator calibrated in 0.0001 inch increments, as it is rather difficult to obtain accurate measurements with a micrometer. Set the cylinder bore gage on zero in the special master ring gage.

Also, check the liner for taper and out-of-roundness. Measurements must be made with the liner installed in the proper bore of the cylinder block.

h. To reuse the liner, the taper must not exceed 0.002 inch and the out-of-roundness must not exceed 0.003 inch. In addition, the ridge formed at the top of the ring travel must be removed. If the out-of-roundness exceeds 0.002 inch, rotate the liner 90 degrees in the block bore and recheck.

i. Replace the cylinder liner if it fails to meet the above specifications.

j. Used cylinder liners must always be honed before reinstallation to break the glaze which results after long operating periods. The ridge at the top of the liner must also be removed (see the ridge removal instructions in paragraph 3-93). To hone a cylinder liner, proceed as follows:

Note. Do not hone new cylinder liners.

(1) Place the cylinder liner in a holding fixture, if one is available (a scrap cylinder block makes an excellent holding fixture).

Caution: **A cylinder liner may be honed in its own cylinder block if the block is stripped of all components. After honing, the block must be cleaned thoroughly to remove all abrasive material.**

(2) Use 120-grit stones and hone the cylinder liner in a criss-cross pattern that produces hone marks on a 45 degree axis.

Note. This operation may be performed with emery cloth if a hone is not available.

(3) After honing, remove the liner from the holding fixture and clean it thoroughly with approved solvent. Dry the liner with compressed air and check the entire surface for burrs. Remove burrs, using crocus cloth.

(4) Recheck the liner for taper and out-of roundness as in sub-paragraph *h*. Check the piston to liner clearance. See paragraph 3-96 for instructions on checking the piston-to-liner clearance.

3-110. Installation

a. If a cylinder liner has been removed from the engine bore, the cylinder liner, piston, and connecting rod should be installed in the bore as an assembly. To install these assemblies, proceed as follows:

(1) Wipe the inside and outside of the liner clean and make sure the bore in the block is clean.

(2) Check for and remove any burrs on the cylinder liner or in the cylinder bore.

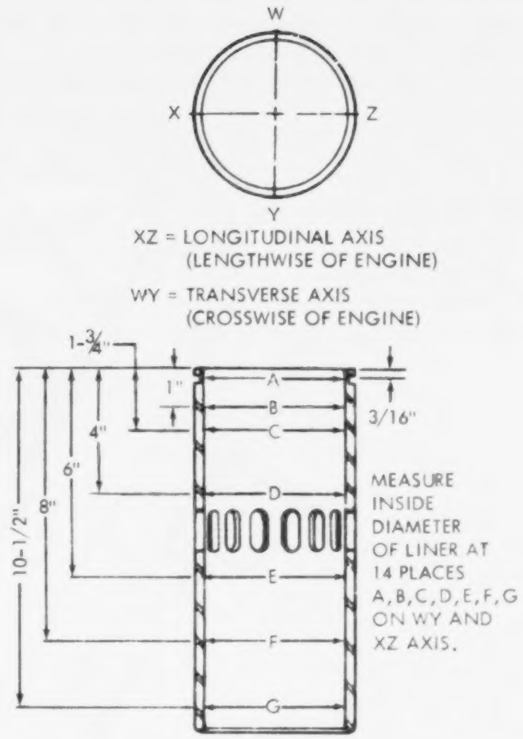
W
X
Z
Y
XZ = LONGITUDINAL AXIS (LENGTHWISE OF ENGINE)
WY = TRANSVERSE AXIS (CROSSWISE OF ENGINE)
1-3/4"
1"
4"
6"
8"
10-1/2"
3/16"
A
B
C
D
E
F
G
MEASURE INSIDE DIAMETER OF LINER AT 14 PLACES A,B,C,D,E,F,G ON WY AND XZ AXIS.

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Figure 3-57. Cylinder liner measuring diagram.

(3) Make sure the counterbore in the block is clean so the liner insert will seat properly. The counterbore must be 0.4770 to 0.4795 inch in depth and must not vary more than 0.0015 inch in depth around the entire circumference.

(4) Place the liner insert in the counterbore in the cylinder block. The top face of the cylinder liner flange must be 0.045 to 0.050 inch below the top surface of the cylinder block to provide proper sealing of the cylinder head compression gasket (see item 4, fig. 3-36).

(5) Push the cylinder liner in the cylinder block bore until the flange of the cylinder liner rests on the insert. (fig. 3-58).

Caution: **Do not use excessive force to install the cylinder liner in the block bore.**

(6) Clamp the liner in place with holddown clamps as shown in figure 3-59.

(7) Measure the distance from the top of the liner flange to the top of the clock with a dial indicator as shown in figure 3-59. When in place, the top of the liner flange must be 0.045 to 0.050 inch below the top surface of the block. There must not be over 0.001 inch difference in height

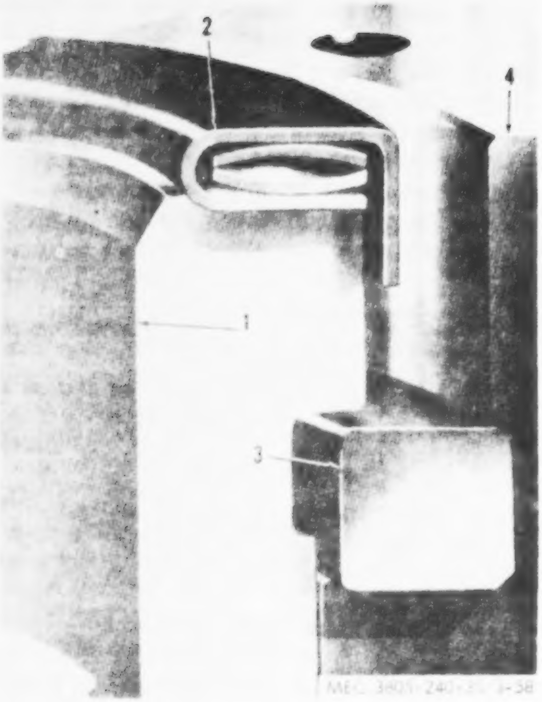

Figure 3-58. Cylinder liner installation.

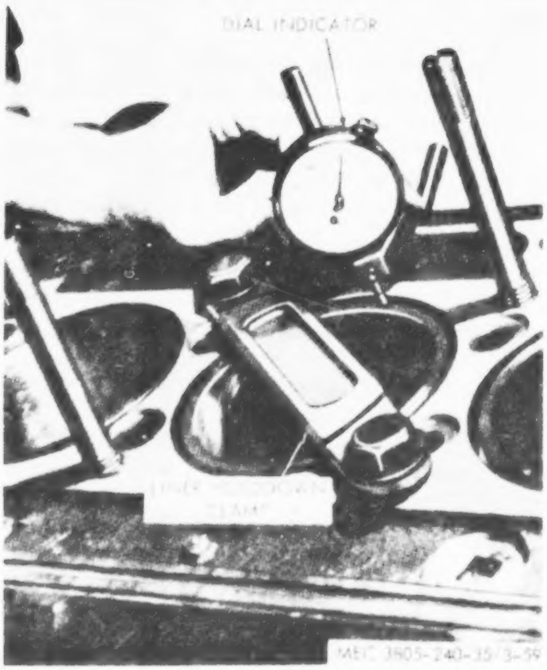

Figure 3-59. Checking distances of cylinder liner below top of block.

below the top of the block between any two adjacent liners when measured along the longitudinal center of the cylinder. If the above limits are not met, install the liner in another cylinder and recheck, or use a new cylinder liner.

(8) Matchmark the liner and block with chalk or paint so the liner may be reinstalled in the same position in the block bore. Place the matchmark on the side opposite the camshaft.

(9) Remove the holddown clamps and liner from the cylinder block.

Note. Do not remove the cylinder liner insert.

(10) With the piston assembled to the connecting rod and the piston rings in place as outlined in paragraph 3-97, apply clean engine oil to the piston, rings and the inside surface of the piston ring compressor.

Caution: **Inspect the ring compressor for nicks or burrs, especially at the nontapered inside diameter end. Nicks or burrs on the inside diameter of the compressor will result in damage to the piston rings.**

(11) Place the piston ring compressor on top of a wood block, with the chamfered end of the ring compressor facing up.

(12) Position (stagger) the piston ring gaps properly on the piston. Make sure the ends of the oil control ring expanders are not overlapped.

(13) Start the top of the piston straight into the ring compressor. Then, push the piston down until it contacts the wood block.

(14) Note the position of the matchmark and place the liner, with the flange end down, on the wood block.

(15) Place the ring compressor, piston and connecting rod assembly on the liner, with the numbers on the side of the connecting rod and cap facing the same side as the matchmark on the liner.

Caution: **The numbers on the side of the connecting rod and cap identify the rod with the cap and indicate the particular cylinder in which they are used. If a new service connecting rod is to be installed, the same identification number must be stamped in the same location as on the connecting rod that was replaced.**

(16) Push the piston and connecting rod assembly down into the liner until the piston is free of the ring compressor.

Caution: **Do not force the piston into the liner.**

(17) Remove the connecting rod cap and the ring compressor. Then, push the piston down until the compression rings pass the liner ports.

b. After the piston and connecting rod assembly have been installed in the cylinder liner, the entire assembly may then be installed in the engine as follows:

(1) If any of the pistons and liners are already in the engine, use holddown clamps to retain the liners in place when the crankshaft is rotated.

(2) Rotate the crankshaft until the connecting rod journal of the particular cylinder being worked on is at the bottom of its travel. Wipe the journal clean and lubricate it with clean engine oil.

(3) Install the upper bearing shell—the one without the continuous oil groove—in the connecting rod. Lubricate the bearing shell with clean engine oil.

Caution: **Each connecting rod and its cap is numbered on one side—1L, 1R, 2L, 2R, etc. These numbers and letters identify the caps with the rods and indicate the particular cylinder in which they are used. Maintain these positions when assembling the engine.**

(4) Position the piston, connecting rod and liner assembly in front of the cylinder block bore so that the identification number and letter on the connecting rod face the outer edge of the cylinder block and the matchmark on the liner and the block are in alignment. Carefully guide the end of the connecting rod through the block bore to avoid damaging and dislodging the bearing shell. Then, slide the piston, connecting rod and liner assembly straight into the block bore until the liner flange rests on the insert in the counterbore.

(5) Push or pull the piston and connecting rod into the liner until the upper bearing shell is firmly seated on the crankshaft journal.

Caution: **The distance from the vertical center line of the connecting rod bolts to the edges of the rod are not equal. Therefore, when installing the piston and connecting rod assembly, be sure that the narrow side of the two connecting rods on the crankshaft journal are together to avoid cocking of the rod.**

(6) Place the lower bearing shell—the one with the continuous oil groove from one parting line to the other—in the connecting rod bearing cap, with the tang on the bearing shell in the notch in the bearing cap. Lubricate the bearing shell with clean engine oil.

(7) Install the bearing shell and cap on the connecting rod with the identification numbers adjacent to each other. Tighten the connecting rod nuts to 65-75 foot-pounds torque.

(8) Check the connecting rod side clearance. The clearance between each pair of connecting rods should be 0.008 to 0.016 inch with new parts.

(9) Install the remaining liner, piston and rod assemblies in the same manner. Use holddown clamps to hold each liner in place when rotating the crankshaft.

(10) After all of the liners and pistons have been installed, remove the holddown clamps.

(11) Install the compression gaskets and water and oil seals as outlined in paragraph 3-76. Then, install the cylinder head and any other parts which were removed from the engine.

(12) Refer to current lubrication order and refill the crankcase to the proper level on the dipstick.

(13) If new parts such as pistons, rings, liners or bearings were installed, operate the engine on the run-in schedule given in paragraph 3-196 and table 3-1 to permit the mating parts to wear in properly before being subjected to full load operation. If available, it is preferable to use a dynamometer for the run-in.

Section XVIII. FLYWHEEL AND FLYWHEEL HOUSING

3-111. General

a. The flywheel is part of the transmission assembly and is attached to the crankshaft by means of a flex-plate. A ring gear on the flywheel transmits the cranking force from the starting motor to the crankshaft.

b. The flywheel housing is a one-piece casting mounted against the rear end plate, which is attached to the cylinder block, thus providing a cover for the gear train and flywheel. It also serves as a support for the starting motor and transmission.

3-112. Removal of Flywheel

Refer to paragraph 3-111 and remove flywheel.

3-113. Disassembly

a. Although the flywheel seldom wears to the point of requiring replacement, the flywheel ring gear may become worn due to normal usage or damaged by improper use of the starting motor to the extent that it must be replaced. Examine the teeth on the ring gear. If replacement of the ring gear is necessary, remove the ring gear as outlined below.

b. Before removing the ring gear from the flywheel, note whether the teeth are chamfered. The replacement gear must be installed so the chamfer on the teeth faces the same direction with relationship to the flywheel as on the gear that is to be removed. Then, remove the ring gear as follows:

(1) Support the flywheel, crankshaft side down, on a solid flat surface or a hardwood block, which is slightly smaller than the inside diameter of the ring gear.

(2) With a suitable drift and hammer, drive the ring gear off of the flywheel. Work around the circumference of the ring gear to avoid binding the gear on the flywheel.

3-114. Cleaning

Remove all grease deposits with solvent and dry with compressed air.

3-115. Inspection and Repair

a. Check the surfaces of the flywheel for scoring, overheating or cracks.

b. Inspect the ring gear for damage or excessive wear. Replace the ring gear if necessary.

3-116. Reassembly

a. Support the flywheel, ring gear side up, on a solid flat surface.

b. Rest the ring gear on a flat metal surface and heat the ring gear uniformly with an acetylene torch, keeping the torch moving around the gear to avoid hot spots.

***Caution:* Do not, under any circumstances, heat the gear over 400° F.; excessive heating may destroy the original heat treatment.**

Note. Heat indicating "crayons", which are placed on the ring gear and melt at a pre-determined temperature, may be obtained from most tool vendors. Use of one of these "crayons" will insure against overheating the gear.

c. Use a pair of tongs to place the gear on the flywheel with the chamfer, if any, facing the same direction as on the gear just removed.

d. Tap the gear into place against the shoulder on the flywheel. If the gear cannot be tapped into place readily, remove it and apply additional heat, heeding the above caution about overheating.

3-117. Installation of Flywheel

Refer to paragraph 3-122 and install the flywheel.

3-118. Removal of Flywheel Housing

a. Remove all accessories attached to the flywheel housing.

b. Remove the oil pan.

c. Remove bolts (1, 3 and 5, fig. 3-60) and lockwashers (2, 4, 6) located in the bell of the housing.

d. Remove bolt and washer (7, 8) located behind small hole cover (32).

e. Remove remaining bolts (9, 11, 13) and lockwashers (10, 12, 14) around the upper portion of the housing and the two bolts which go through the cylinder block end plate from the front and thread into the housing.

f. Install flywheel housing alineing studs into bolt holes on housing to guide housing until it clears the crankshaft during removal.

g. Support housing with chain hoist attached to lifter brackets (39). Strike front face of the housing alternately on each side with a soft hammer to work it off the dowels and away from the end plate. Remove housing (15).

3-119. Disassembly

Unless individual covers (19, 26, 32) are damaged, there is no disassembly required.

3-120. Cleaning

Clean the flywheel housing with clean fuel oil and dry with compressed air.

3-121. Inspection and Repair

a. Inspect the crankshaft rear oil seal. Remove and replace if necessary.

b. Inspect crankshaft for wear, dirt buildup or other defects. Clean thoroughly with solvent. Dry with compressed air. If necessary, smooth crankshaft with emery cloth and polish with crocus cloth wet with fuel oil.

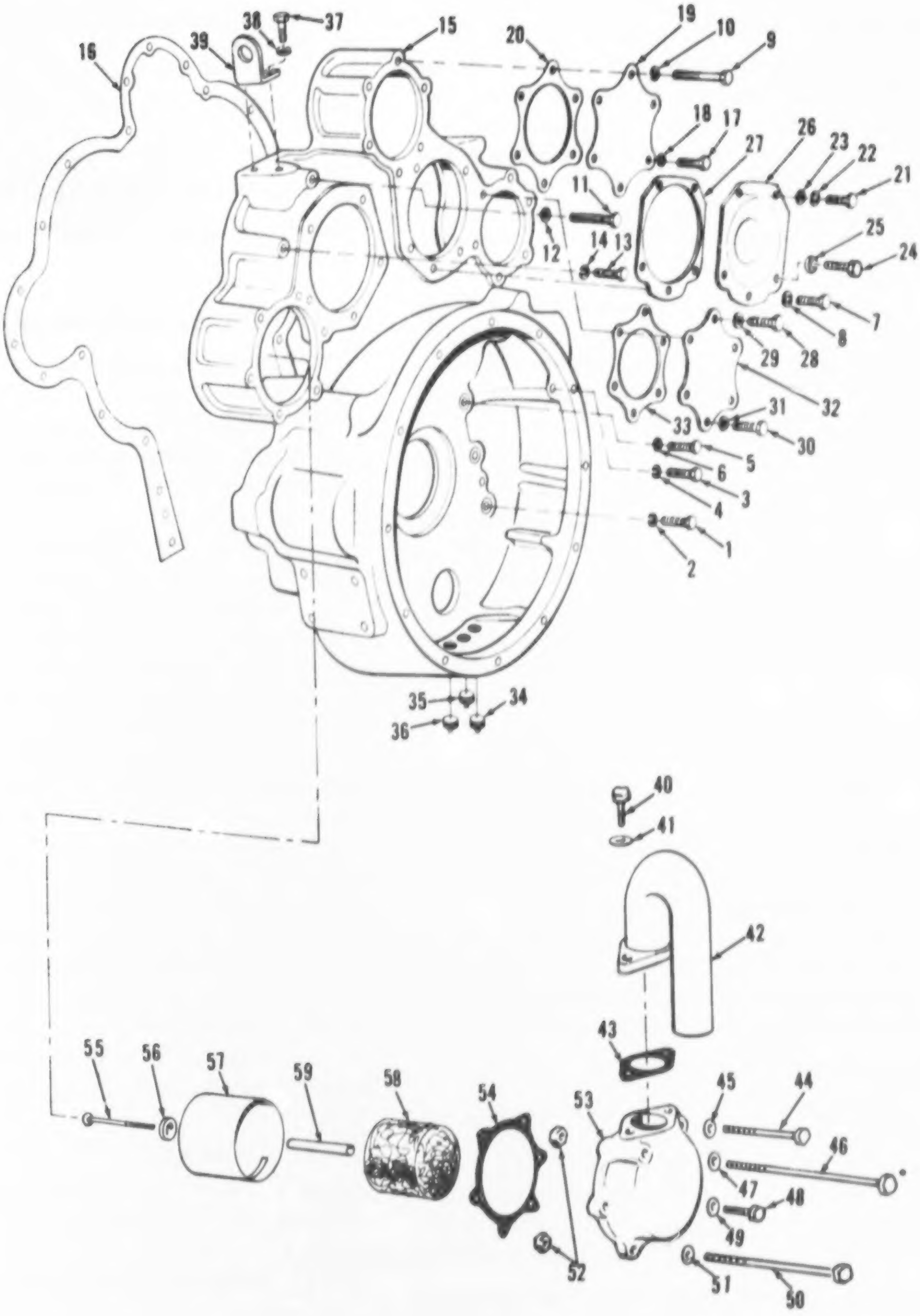
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Figure 3-60. Flywheel housing, exploded view.

1	Bolt (6 rqr)
2	Lockwasher (6 rqr)
3	Bolt (2 rqr)
4	Lockwasher (2 rqr)
5	Lock bolt (6 rqr)
6	Flat washer (6 rqr)
7	Bolt
8	Washer
9	Bolt
10	Lockwasher
11	Bolt
12	Lockwasher
13	Bolt (7 rqr)
14	Lockwasher (7 rqr)
15	Housing
16	Gasket
17	Bolt (5 rqr)
18	Lockwasher (5 rqr)
19	Cover
20	Gasket
21	Bolt
22	Lockwasher
23	Copper washer
24	Bolt (4 rqr)
25	Lockwasher (4 rqr)
26	Cover
27	Gasket (2 rqr)
28	Bolt (2 rqr)
29	Lockwasher (4 rqr)
30	Bolt (4 rqr)
31	Lockwasher (8 rqr)
32	Cover
33	Gasket
34	Pipe plug, 3/4 in.
35	Pipe plug, 1 in.
36	Pipe plug, 1-1/4 in.
37	Bolt (4 rqr)
38	Lockwasher (4 rqr)
39	Lifter bracket (2 rqr)
40	Bolt (2 rqr)
41	Lockwasher (2 rqr)
42	Pipe, breather
43	Gasket
44	Bolt
45	Lockwasher
46	Bolt
47	Lockwasher
48	Bolt
49	Lockwasher
50	Bolt (3 rqr)
51	Lockwasher (3 rqr)
52	Nut (4 rqr)
53	Body, breather
54	Gasket
55	Bolt
56	Washer
57	Shell, breather
58	Pad, breather
59	Spacer, breather shell

Figure 3-60—Continued

3-122. Reassembly

If crankshaft rear oil seal was removed, replace with new seal as follows:

a. Support inner face of the flywheel housing on a flat surface.

b. If oil seal is not precoated, coat the bore in the housing with a nonhardening sealent.

c. Position the seal bore with the lip of the seal pointed toward the inner face of the housing.

d. Drive the seal until it seats against the shoulder in the bore. Use crankshaft rear oil seal installer and driver handle.

3-123. Installation of Flywheel Housing

a. Affix new gasket (16, fig. 3-60) to flywheel housing.

b. Lubricate the gear train teeth with clean engine oil.

c. Coat the lip of the oil seal lightly with grease. Do not scratch or nick sealing edge of the oil seal.

d. Thread the aligning studs into the cylinder block to guide the housing in place.

e. Use crankshaft oil seal expander to pilot the oil seal over the crankshaft.

f. Use chain hoist inserted in lifter brackets and position housing over crankshaft and against the cylinder block end plate and gasket. Remove the oil seal expander.

g. Install the six lock bolts (3/8-16 x 1 inch) and washers in position 1-6 (fig. 3-61), finger tight only.

h. Remove the aligning studs and install the six 1/2-13 x 3 1/4 inch bolts with lockwashers, finger tight.

i. Install remaining attaching bolts and lockwashers, finger tight.

j. Refer to figure 3-61 for bolt tightening sequence, operation 1.

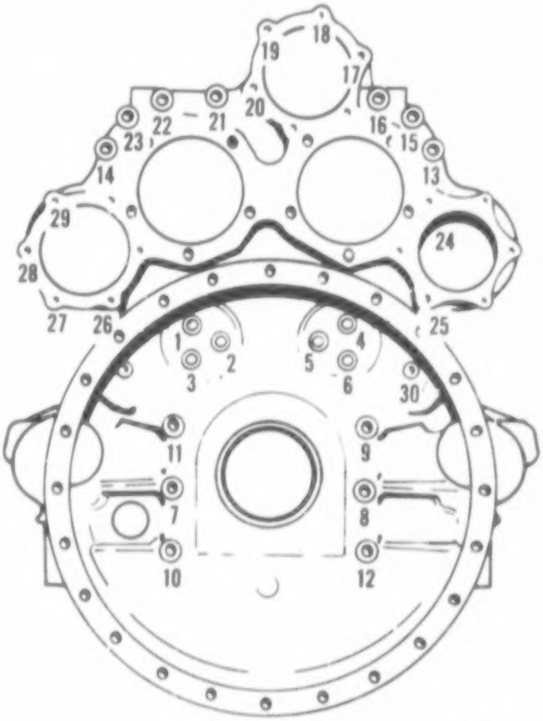

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Figure 3-61. Flywheel housing assembly, bolt tightening sequence, operation No. 1.

***Caution:* When tightening the idler gear hub bolts (Positions 4, 5, and 6) turn the crankshaft to prevent any binding in the idler gear bearing assembly.**

k. Refer to figure 3-62 for final tightening sequence. See paragraph 1-4 for torque specifications.

l. Install the flywheel (the flywheel is used at this point for checking the concentricity of the flywheel housing). It will be assembled to the torque converter assembly for final reassembly.

(1) Use chain hoist and flywheel lifting hook connected to flywheel and two 7/16-14 bolts of suitable length.

(2) Position flywheel on dowels on the crankshaft.

(3) Remove lifting hook.

(4) Attach flywheel plate and six bolts to crankshaft. Tighten bolts to 180-190 foot-pounds torque.

m. Check flywheel housing concentricity and bolting flange face with flywheel housing concentricity gage as follows:

(1) Refer to figure 3-63 and thread the base post of gage tightly into one of the tapped holes in the flywheel. Assemble the indicators on the base post.

(2) Position the indicators true and square with the housing.

(3) Pry and hold the crankshaft in one direction to insure end play is one direction only.

(4) Adjust each dial indicator to read zero at the twelve o'clock position. Rotate the crankshaft one full revolution. Take eight equally spaced readings of the flywheel housing bore and bolting flange face. The maximum total indicator reading must not exceed 0.013 inch for either the bore or face.

(5) If the run-out exceeds the allowable limits, remove the housing and check for warpage caused by dirt, foreign material, such as old gasket material between end plate and housing or end plate and cylinder block. Reinstall housing and recheck the run-out. If necessary replace the flywheel housing.

n. Remove the flywheel by reversing assembly procedure (para 3-111). Set flywheel aside for reassembly to torque converter.

o. Install the oil pan.

p. Replace the starting motor and other accessory items attached to flywheel housing.

q. Attach torque converter to engine (para 2-41).

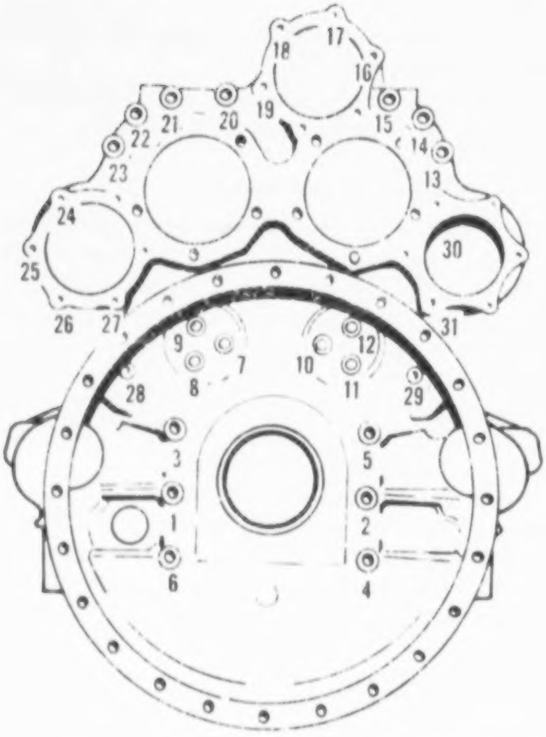

Figure 3-62. Flywheel housing assembly, bolt tightening sequence, operation No. 2.

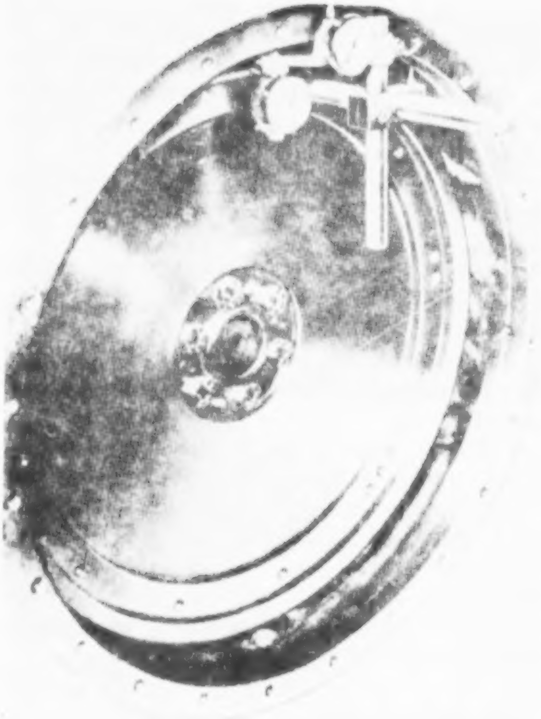

Figure 3-63. Checking flywheel housing concentricity.

Section XIX. BALANCE WEIGHTS AND HOUSING

3-124. General

The balance weights are incorporated in the design of the front balancer pulley and the camshaft gear which are connected to the front ends of the right and left hand camshafts, respectively. The balance weight housing is one piece casting that covers the left camshaft gear. Since their removal and service is directly related to any camshaft overhaul procedure, they are covered in paragraph 3-125 immediately following.

Section XX. CAMSHAFTS AND BALANCE SHAFT

3-125. General

The camshafts are located near the top of the cylinder block. A left cylinder bank and a right cylinder bank camshaft is provided to actuate the exhaust valve and fuel injector operating mechanism. The accurately ground cams ensure efficient, quiet, cam follower roller action, and are heat treated to provide a hard wear surface.

3-126. Removal

a. Drain the cooling system.

b. Remove engine and mount on overhaul stand (para 2-40).

c. Remove the cylinder heads (para 3-72).

d. Remove the flywheel and flywheel housing (para 3-111).

e. Refer to TM 5-3805-240-12 and remove the water pump.

f. Remove the balance weight housing (cover).

(1) Remove bolts and washers attaching cover to cylinder block and end plate.

(2) Remove gasket.

g. Remove bolts (10, fig. 3-64) that secure nut retainer plates (13) to the camshaft gears. Remove the plates.

h. Wedge a clean rag between the gears and remove the gear retaining nuts (14, 16 and 18) from both ends of each camshaft (29 and 30).

i. Attach bar type puller to the camshaft pulley (21). Use puller adapter between the end of the camshaft and the pulley screw to protect the end of the camshaft.

j. Remove the water pump drive gear (19) using the bar type puller (3 arm), and puller adapter.

k. Remove the woodruff key (20 and 22) and the spacer (23 and 24) from the front end of each camshaft.

l. Remove all of the camshaft intermediate bearing lockscrews (26) from the top of the cylinder block.

m. Rotate gears as required to reveal the end bearing retaining bolts (27); remove the bolts.

n. Withdraw camshaft bearing and block assembly from the cylinder block.

o. Remove front end bearing retaining bolts (33) lockwashers (34). Withdraw bearings (37 and 35) from the cylinder block. Use pry bar under flange if necessary.

3-127. Disassembly

a. Remove gears (38 and 39, fig. 3-64) from camshafts as follows:

(1) Place camshaft and gear in arbor press supporting gear on platform of press.

(2) Place a wooden block under the lower end of the camshaft to protect threads.

(3) Place a short one inch diameter brass rod on end of camshaft and press the shaft out of the gear. Remove woodruff key (40) if necessary.

b. Slide the rear bearing (41 and 42) and thrust washer (43) off camshaft.

c. Remove lock ring (31) and bearings (32).

d. Remove end plugs (45 and 46) as follows:

(1) Clamp camshaft in vise equipped with soft jaws.

(2) Indent center of plug with 31/64 inch carboloy tip drill.

(3) Drill hole through plug with 1/4 inch carboloy tip drill, follow with 5/16 inch size.

(4) Tap hole with a 3/8-16 NC tap.

(5) Thread puller adapter into plug. Attach slide hammer to adapter and remove plug.

(6) Insert 3/8 inch steel rod in the oil passage and drive out the remaining plug.

3-128. Cleaning

a. Soak the camshaft in clean fuel oil. Run a wire brush through the oil gallery to remove sludge or foreign material. Clean outside of camshaft.

b. Blow out the oil gallery and oil holes with compressed air.

c. Clean the gears, bearings, and related parts with fuel oil. Dry with compressed air.

3-129. Inspection and Repair

a. Inspect cams and journals for wear or scoring. if scored, inspect the cam followers (para 3-75). Inspect keyways and threads for damage.

b. Inspect bearings and thrust washers and the camshaft and gear faces which contact the thrust washers. Replace as required. Smooth minor scratches with an oil stone. Clearance between the thrust washer and the thrust shoulder of the camshaft shall be 0.004—0.018 inch.

c. Inspect bushings in the end bearings. Replace if badly worn. Finish bore new bushings to a 20 RMS finish after installation. Bushing should sustain 2000 pound end load without moving. Inside diameter of bushings must be square with rear bearing face within 0.0015 inch total indicator reading and concentric with outside of bearing housing within 0.002 inch total reading. Rear end bearing bushings must project 0.045—0.055 inch from each end of bearing. Front end bearing bushing must be flush with ends of the bushing bore.

d. Clearance between the camshaft end journals and camshaft and bearing bushings is 0.0025—0.006 inch.

e. Inspect oil seal (25, fig. 3-64) for wear or damage. Replace as required. Inspect spacers (23 and 24) for wear or damage. Replace as required.

f. Inspect bearings (32) for excessive wear or scoring. Clearance between journals and bearings must be 0.0025—0.009 inch. Replace as required.

g. Check all gears for scoring, pitting or excessive wear of teeth. Replace as required.

3-130. Reassembly

a. Install new end plugs (45 and 46, fig. 3-64).

b. Grease face of thrust washers (43 and 44). Place washer against each end of rear bearings (41 and 42). Be sure the steel face of washer is next to the bearing.

c. Lubricate rear bearing journals and install rear bearings in camshaft.

d. Install the gears (38 and 39) as follows:

(1) Install woodruff key (40) if removed.

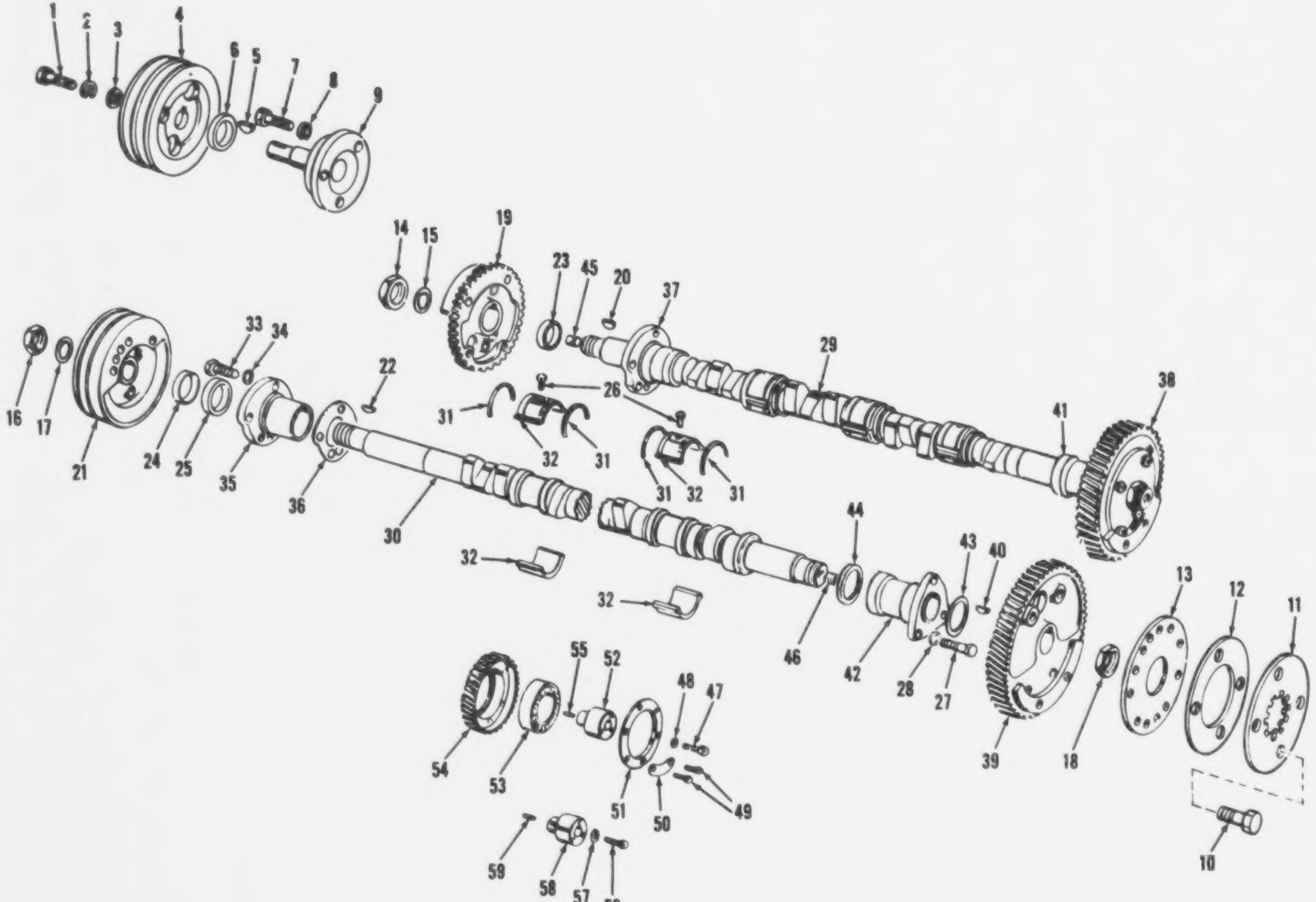
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Figure 3-64. Camshaft assembly, exploded view.

1 Bolt
2 Lockwasher
3 Washer
4 Pulley
5 Woodruff key
6 Oil seal
7 Bolt (3 rqr)
8 Lockwasher (3 rqr)
9 Hub
10 Bolt (8 rqr)
11 Pump drive plate
12 Spacer
13 Retainer
14 Nut
15 Lockwasher
16 Nut
17 Lockwasher
18 Nut
19 Drive gear
20 Woodruff key
21 Pulley
22 Woodruff key
23 Spacer
24 Spacer
25 Oil seal
26 Lockscrew (4 rqr)
27 Bolt (6 rqr)
28 Lockwasher (6 rqr)
29 Camshaft, right bank
30 Camshaft, left bank
31 Lock ring (8 rqr)
32 Bearing set (4 rqr)
33 Bolt (6 rqr)
34 Lockwasher (6 rqr)
35 Bearing
36 Gasket
37 Bearing
38 Gear
39 Gear
40 Woodruff key
41 Bearing
42 Bearing
43 Thrust washer
44 Thrust washer
45 End plug
46 End plug
47 Bolt (6 rqr)
48 Washer (6 rqr)
49 Bolt (3 rqr)
50 Bolt lock (3 rqr)
51 Retainer
52 Hub
53 Bearing
54 Gear
55 Dowel
56 Bolt (3 rqr)
57 Washer (3 rqr)
58 Spacer
59 Dowel

Figure 3-64—Continued

(2) Start gear over the end of the camshaft with key and keyway alined properly.

(3) Support camshaft in an arbor press, place sleeve on top of gear and press gear into place against the shoulder on the camshaft.

(4) Thread nut (18) on camshaft. Tighten after installation in the engine.

e. Lubricate the camshaft intermediate journals. Place bearing halves (32) on journal and install lock rings (31).

3-131. Installation

a. Insert camshaft (29, fig. 3-64) through rear end plate. Work through carefully until the gear (38) is about to engage mating gear.

b. Aline timing marks (fig. 3-65) and slide gear in place.

c. Install bolts (27, fig. 3-64) and lockwashers (28) in rear end bearing (41) and secure to block. Tighten bolts to 35-40 foot-pounds torque.

d. Revolve intermediate bearings to aline with tapped holes in cylinder block. Install lockscrews (26) and tighten to 15-20 foot-pounds.

e. Install the other camshaft in the same manner.

f. Attach new gasket (36) to bearing (35). Lubricate the journal and slide bearing on camshaft. Install bolts (33) and lockwashers (34). Tighten bolts 35-40 foot-pounds torque.

g. Install bearing (37). Secure to block in the same manner.

h. Select spacer (24) with polished outside surface. Lubricate and install in camshaft (30); install other spacer (23) on camshaft (29).

i. Install Woodruff keys (20 and 22).

j. Install pulley (21) and gear (19). Install lockwashers (15 and 17). Start nuts (14 and 16) on the camshafts.

k. Wedge clean rag between the gears and tighten nuts to 300-325 foot-pounds torque.

l. Install retainer (13), and bolts (10). Tighten to 35-39 foot-pounds torque.

m. Check clearance between thrust washers and shoulder of camshaft. Allowable clearance is 0.004—0.018 inch.

n. Check backlash between mating gears. New gear backlash shall be 0.003—0.008 inch. Maximum allowable clearance of worn gears shall be 0.010 inch.

o. Replace gasket and balance weight cover. Install washers, lockwashers and bolts. Tighten to standard torque specifications (para 1-4).

p. Refer to TM 5-3805-240-12 and reinstall water pump.

q. Replace flywheel housing and flywheel (para 4-35 and 3-118).

r. Replace cylinder heads (para 3-72).

s. Refill cooling system.

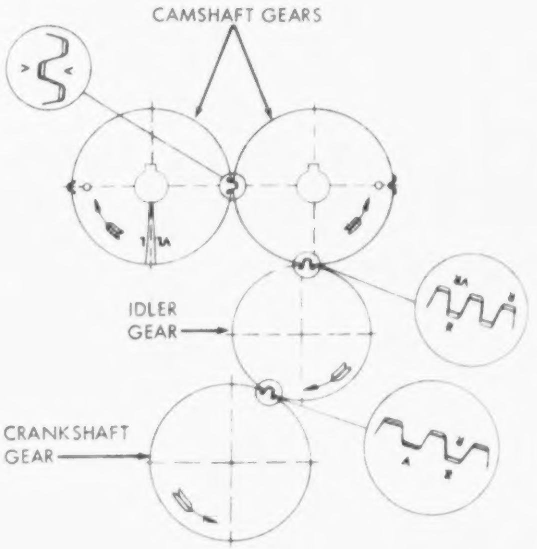

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Figure 3-65. Camshaft gear timing marks.

Section XXI. IDLER GEAR ASSEMBLY

3-132. General

a. The idler gear is mounted on a double row, tapered roller bearing, which in turn is supported on a stationary hub. This hub is secured directly to the cylinder block by a bolt which passes through the hub and rear end plate. A dowel in the hub correctly positions the hub and prevents it from rotating.

b. An idler gear hole spacer (dummy hub) is used on the side opposite the idler gear.

3-133. Removal of Idler Gear Assembly

a. Remove flywheel housing (para 4-35 and 3-118).

b. Remove bolt (47, fig. 33-64), and washer (48). Remove gear hub and bearing assembly from the engine.

Note. Before removing gear with both hands and rock it. If gear wobbles the bearing must be replaced. If there is no perceptible wobble, it is only necessary to check the bearing preload before reinstalling assembly.

3-134. Disassembly

a. Remove bolts (49, fig. 3-64) and bolt locks (50) remove retainer (51).

Note. The component parts of the bearing (53) are matched. Matchmark parts during disassembly to ensure proper reassembly.

b. Place gear assembly in arbor press, supporting bearing cone on steel blocks. Rotate bearing cone to prevent brinnelling of the bearing and press the hub out of the bearing.

c. Tap bearing cup from the idler gear using brass drift alternately placed at the four notches in the gear shoulder.

3-135. Cleaning

Wash all parts thoroughly in clean fuel oil. Dry with compressed air.

3-136. Inspection and Repair

a. Inspect gear teeth for scoring, pitting or excessive wear. Replace as required.

b. Inspect the hub for wear or damage.

c. Inspect the bearing for wear, damage or flat spots. Replace as required.

3-137. Reassembly

a. Support the idler gear, shoulder in the bearing bore down, in an arbor press. Place the bearing cup in position on the gear and press into place tight against the shoulder using steel plate between cup and the ram.

b. Support one bearing cone, numbered side down, on the bed of the arbor press. Place gear and cup assembly over the cone.

c. Place the spacer ring on the bearing cone. Place the second bearing cone, numbered side up in the assembly against the spacer ring.

d. Position the hub (52, fig. 3-64) over the bearing cones with the oil hole in the hub 180 degrees from the gap in the spacer ring

e. Rotate gear to seat the rollers and press the hub into the cones until face of hub (with dowel) is flush with face of inner bearing cone.

***Caution:* The bearing cones must always be supported so rollers do not absorb damaging loads.**

f. Check the bearing assembly preload with crankshaft and camshaft and camshaft gears removed from engine.

(1) Mount the idler gear assembly on the engine.

(2) Install bolt (47) and washer (48). Tighten bolt to 80-90 foot-pounds torque.

(3) Place steel plate (see lower plate, figure 3-66) against hub and bearing. Insert 3/8-16NC bolts through plate and thread into hub. Tighten bolts to 25-40 foot-pounds torque (fig. 3-67).

(4) Tie an end of a piece of lintless 1/8 inch cord around a 1/8 inch round piece of wood. Place the wood between of the gear teeth and wrap cord around the gear several times (fig. 3-68).

(5) Attach other end of cord to a special spring scale. Maintain a steady pull on the cord, 90 degrees to axis of the hub, and note pull in pounds and ounces required to start the gear rotating. Make several checks to obtain an average reading.

(6) Pull between 1/2 pound to 6 pounds 12 ounces and a fluctuation of not more than 2 pounds 11 ounces is acceptable. A scale reading of less than 1/2 pound usually indicates a worn bearing. However, if no wobble is present (para 3-133) the assembly may be used. If a wobble is noted, replace the bearing. A scale

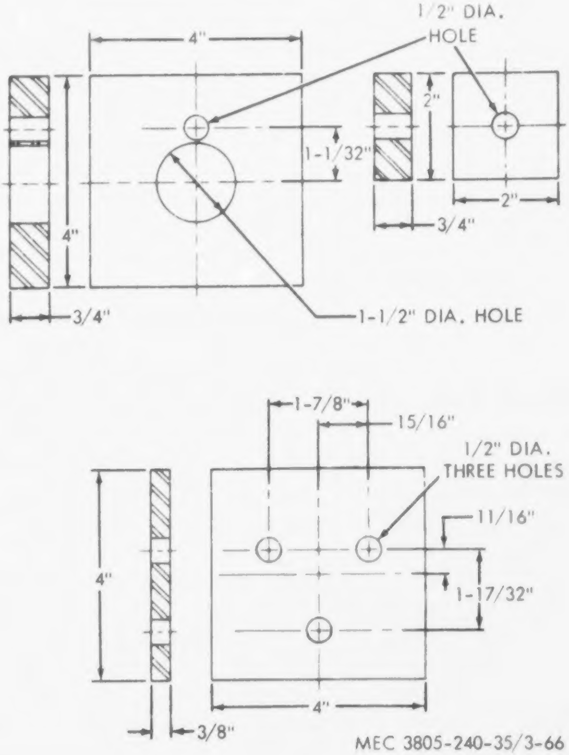

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Figure 3-66. Clamp plates for bearing test fixture.

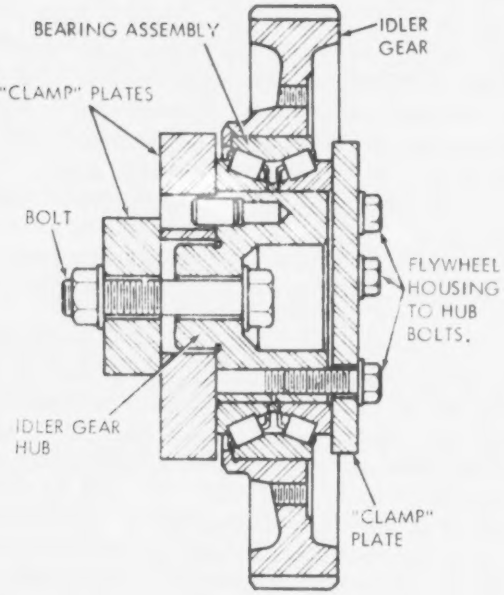

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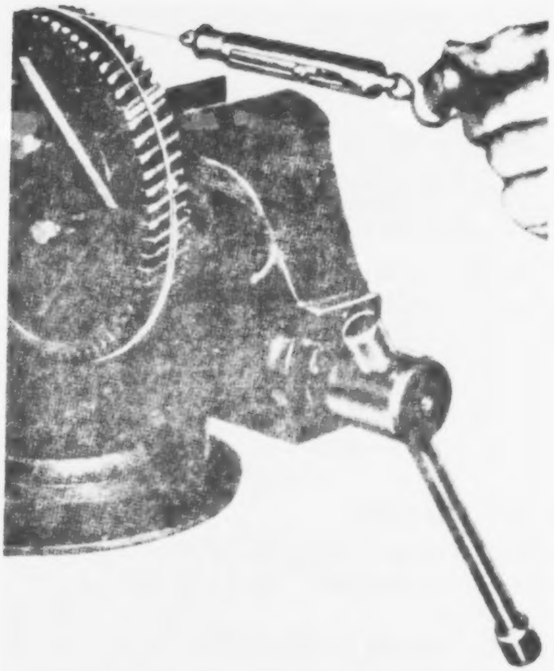
Figure 3-67. Fixture for testing bearing pre-load.



MEC 3805-240-35/3-68

Figure 3-68. Checking idler gear bearing pre-load.

reading of more than 6 pounds 12 ounces indicates binding of rollers or improper installation. Disassemble bearing and inspect. Replace if required. A fluctuation of more than 2 pounds 11 ounces may be caused by damaged bearings, improper installation or foreign material in the bearings. Disassemble and trace cause. Replace bearings if required.

g. Check the bearing assembly preload with crankshaft and camshaft gears mounted on engine.

(1) Prepare two plates (see upper plates, figure 3-66). Attach to hub (52, fig. 3-64) with a 1/2-13NC x 2 3/4 inch bolt, two 1/2 inch washers and a 1/2-13 NC nut (fig. 3-67). Tighten bolt to 80-90 foot-pounds torque.

(2) Attach third plate as in paragraph *f* above.

(3) Clamp idler gear assembly and fixture in a vise (fig. 3-68).

(4) Follow steps as outlined in *f* above.

h. Attach retainer (51, fig. 3-64) to idler gear (54) with bolts (49) and bolt locks (50). Tighten bolts to 24-29 foot-pounds torque. Bend ears of bolt locks (50) against sides of bolts to secure.

3-138. Installation of Idler Gear Assembly

a. Position crankshaft gear and camshaft gear so timing marks align properly with idler gear (fig. 3-65).

b. Start idler gear in mesh with other gears and simultaneously rotate idler gear so hollow pin in hub nearly registers with oil hole in the end plate.

c. Roll gear into position, alining hollow pin with oil hole. Tap hub against the end plate.

d. Insert bolt (47, fig. 3-64) and washer (48). Tighten bolt to 80-90 foot-pounds torque.

e. Check backlash of mating gears. Tolerance is 0.003—0.010.

3-139. Removal of Idler Gear Hole Spacer

a. Remove bolt (56, fig. 3-64) and washer (57).

b. Remove spacer (58).

3-140. Cleaning

Clean parts in clean fuel oil. Dry with compressed air.

3–141. Inspection and Repair

Inspect parts for damage. Replace as required.

3–142. Reassembly

There are no reassembly procedures for the spacer.

3–143. Installation of Idler Gear Hole Spacer

a. Position spacer (58, fig. 3–64) on end plate of engine.

b. Insert washer (57) and bolt (56). Tighten bolt to 80–90 foot-pounds torque.

c. Replace flywheel housing (see paragraphs 1–35 and 3–118).

Section XXII. BLOWER DRIVE GEAR AND SUPPORT ASSEMBLY

3–144. General

a. The blower drive gear is mounted on a support which is attached to the cylinder block rear end plate. This gear is driven by the right cylinder bank camshaft gear.

b. The blower drive gear bearings are pressure lubricated through an external line from the blower rear end plate to the blower drive support.

c. The blower must be removed prior to removal of the blower drive gear and support assembly.

3–145. Removal

a. Remove blower. Refer to paragraph 3–58 for instructions.

b. Remove two bolts (62, fig. 3–23) and washers (63).

c. Tap assembly away from the end plate.

3–146. Disassembly

a. Clamp support assembly in soft jaws of a bench vise.

b. Remove bolts (65, fig. 3–23) and lockwashers (66). Remove spring plates (70 and 71) and hub (67) as an assembly. Remove bolts (68) and lockwashers (69), to separate hub from plates.

c. Straighten lugs on lockwasher (73) and remove nut (72).

d. Withdraw lockwasher (73), thrust washer (74), thrust bearings (75 and 77) and gear (76) from support (64).

3–147. Cleaning

Clean parts with fuel oil and dry with compressed air. Be sure oil passage in support is clean.

3–148. Inspection and Repair

a. Examine faces of bearings and thrust washers. Replace scored or excessively worn parts.

b. Check inside diameter of bearings in gear for wear. Check outside diameter of hub (67) on which bearings ride. Clearance between bearings and support should be 0.005 inch. Install new parts if clearance exceeds this amount.

c. New bearings must be pressed in flush with sides of gear and pitch diameter of teeth of gear must be within 0.003 inch total indicator reading after reaming bushings to surface finish of 20 micro-inches.

d. Examine gear teeth and hub serrations for wear or damage. Replace as required.

3–149. Reassembly

a. With support in vise as before, position thrust bearing (77, fig. 3–23) on support (64) so that tangs on bearing register with holes in support.

b. Lubricate hub of support, bearings in gear, thrust bearings (75 and 77), and thrust washer (74) with clean engine oil.

c. Slide gear on hub.

d. Install thrust bearing (75) on support with tangs facing away from gear.

e. Position thrust washer (74) on support, registering slots with tangs on bearing (75).

f. Install lockwasher (73) and nut (72). Tighten nut to 50–60 foot-pounds torque. Bend lugs on lockwasher around nut.

g. Check clearance between each thrust bearing and thrust washer as shown in figure 3–69. Clearance shall be 0.005 to 0.010 inch. Clearance shall not exceed 0.012 inch between worn parts.

h. If spring plates (70 and 71, fig. 3–23) were removed from hub (67), reassemble with bolts (68) and lockwashers (69). Tighten bolts to 35–39 foot-pounds torque.

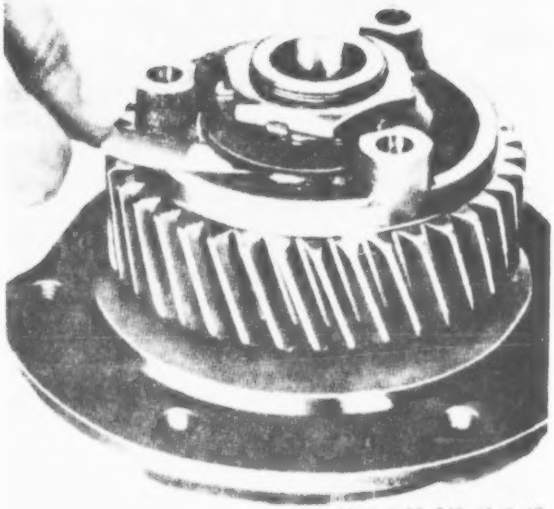
i. Assemble spring plates (70 and 71) and hub (67) to gear with bolts (65) and lockwashers (66).

3-150. Installation

a. Affix new gasket (78, fig. 3-23) to support (64) and attach to end plate with bolts (62) and washers (63). Tighten bolts to 25-30 foot-pounds torque.

b. Check backlash between gear (76) and camshaft gear. Backlash maximum on worn parts shall not exceed 0.010 inch.

c. Install blower. Refer to paragraph 3-58.



MEC 3805-240-35 3-69

Figure 3-69. Checking clearance between thrust washer and thrust bearing.

Section XXIII. CRANKSHAFT FRONT COVER ASSEMBLY

3-151. General

a. The crankshaft front cover is mounted against the cylinder block at the lower front end of the engine. It serves as a retainer for the crankshaft front oil seal. The engine is supported at the front end by means of engine supports attached to the front cover.

b. The crankshaft front cover should not require any servicing, except for the replacement of the oil seal, when such becomes necessary.

c. It will be necessary to remove the crankshaft front cover to remove and install a crankshaft, or when the engine is overhauled.

3-152. Removal

a. Remove the fan and support assembly (para 3-3).

b. Remove the radiator (fig. 2-3).

c. Remove oil pan (fig. 2-3).

d. Block up front of engine and remove support assembly (3, fig. 3-70) with ring (5) from ditcher frame.

e. Remove bolts (6, 8 and 10) and washers (7, 9 and 11) securing trunnion (12) and bolts (13) and washers (14) securing front cover body assembly (15).

f. Strike edges of cover body (15) alternately on each side of engine with a soft hammer to free cover body from dowels. Pull cover body (15) and trunnion (12) straight off end of crankshaft.

g. Remove gasket (16) from cover or cylinder block.

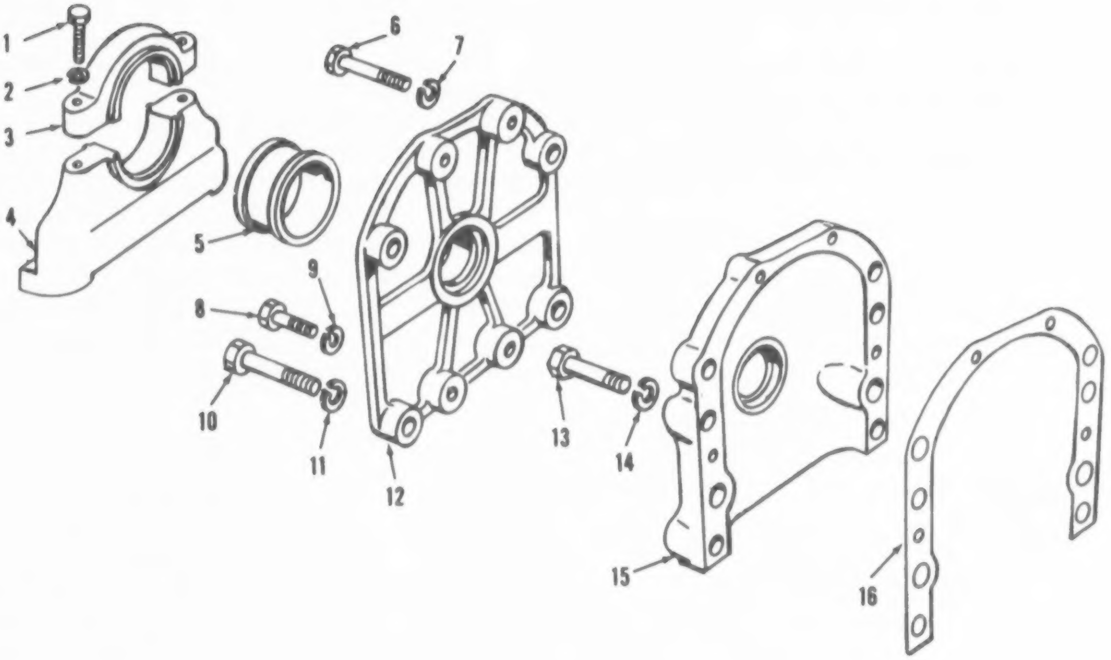
3-153. Cleaning

Clean with approved solvent and dry with compressed air.

3-154. Inspection and Repair

a. Inspect seals for score marks, cracks, or any hardness or brittleness.

b. Inspect cover for cracks or distortion.



MEC 3805-240-35/3-70

1 Bolt, 7/16-14 x 2-1/4 in. (2 rqr)
2 Lockwasher, 7/16 in. (2 rqr)
3 Support assembly, upper (includes items 1 and 2)
4 Support assembly, lower
5 Ring
6 Bolt, 3/8-16 x 4-1/4 in. (2 rqr)
7 Lockwasher (2 rqr)
8 Bolt, 3/8-16 x 1-1/4 in. (2 rqr)
9 Lockwasher, 3/8 in. (2 rqr)
10 Bolt, 1/2-13 x 4-1/2 in. (4 rqr)
11 Lockwasher, 1/2 in. (4 rqr)
12 Trunnion
13 Bolt (8 rqr)
14 Lockwasher (8 rqr)
15 Cover
16 Gasket

Figure 3-70. Crankcase shaft, front cover assembly, exploded view.

3-155. Installation

a. Affix a new gasket (16, fig. 3-70) to inner face of crankshaft front cover body (15).

b. Position crankshaft front cover body (15) and trunnion (12) on the crankshaft; secure with bolts (13, 10, 8 and 6) and washers (14, 7, 11 and 9). Tighten bolts (6 and 8) to 25-30 foot-pounds torque. Tighten bolts (13 and 10) to 80-90 foot-pounds torque.

c. Apply a light coating of engine oil to ring (5) and slide it into place on the crankshaft.

d. Install support assembly (3) with bolts (1) and washers (2).

e. Install oil pan.

f. Install the radiator (para 2-40).

g. Install the fan and support assembly (para 2-40).

Section XXIV. CRANKSHAFT

3-156. General

a. The crankshaft is a one-piece steel forging, heat-treated to ensure strength and durability. All of the main and connecting rod bearing journal surfaces and the oil seal surfaces are induction hardened.

b. Complete static and dynamic balance of the crankshaft has been achieved by counterweights incorporated in the crankshaft.

c. Crankshaft thrust is taken through two-piece washers on each side of the rear main bearing. Full pressure lubrication to all connecting rod and main bearings is provided by drilled passages within the crankshaft and cylinder block.

3–157. Removal

a. Remove engine and torque converter from vehicle (para 2–11).

b. Clean the exterior of engine and torque converter.

c. Drain the cooling system.

d. Drain the engine crankcase.

e. Remove the torque converter (para 2–40).

f. Remove all accessories and assemblies with their attaching parts as necessary to permit the engine to be mounted in an overhaul stand.

g. Mount the engine in an overhaul stand.

h. Remove the oil pan.

i. Remove the flywheel and flywheel housing. (para 4–35 and 3–118).

j. Remove end bolt (1, fig. 3-71) washer (2) pulley (3) and key (4).

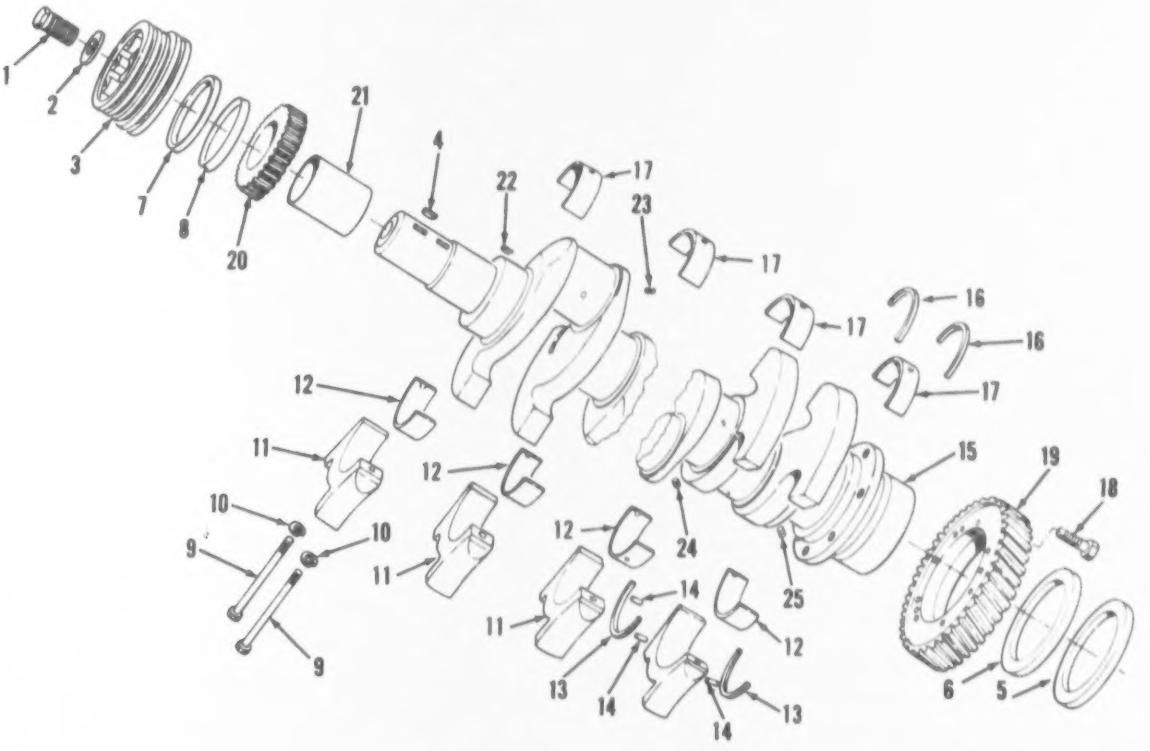
k. Remove the crankshaft front cover. Refer to paragraph 3–152.

l. Remove the oil seal spacer (6) oil seals (5 and 7) and oil slinger (8).

m. Remove the connecting rod bearing caps. Refer to paragraph 3–100.

n. Remove the main bearing caps (11) by removing the bolts (9) and washers (10).

o. Remove the lower bearing shells (12) thrust washers (13) and dowel pins (14) from each side of rear main bearing.



MEC 3805-240-35/3-71

1	Bolt	10	Washer (8 rqr)	19	Timing gear
2	Washer	11	Main bearing cap (4 rqr)	20	Drive gear
3	Pulley	12	Lower bearing shell (4 rqr)	21	Spacer
4	Woodruff key	13	Thrust washer (2 rqr)	22	Woodruff key
5	Seal	14	Pin (4 rqr)	23	Plug
6	Spacer	15	Crankshaft	24	Plug
7	Seal	16	Thrust washer (2 rqr)	25	Plug
8	Slinger	17	Upper bearing shell (4 rqr)		
9	Bolt (8 rqr)	18	Bolt (6 rqr)		

Figure 3–71. Crankshaft, exploded view.

p. Remove crankshaft (15), including the timing gear and oil pump drive gear from the cylinder block with appropriate chain hoist and sling.

3-158. Disassembly

a. Remove the timing gear (19, fig. 3-71) by removing six bolts (18). Use a gear puller if necessary.

b. Remove the oil pump drive gear (20), gear spacer (21), and Woodruff key (22).

3-159. Cleaning

a. Remove plugs (23, 24 and 25, fig. 3-71) and clean out oil passages with stiff wire brush.

b. Clean the crankshaft with fuel oil. Reinstall all the plugs.

3-160. Inspection and Repair

a. Support crankshaft on front and rear journals in V-blocks and check alinement on the two intermediate journals. The runout must not exceed 0.002 inch on each journal. If run-out is greater than 0.002 inch, the crankshaft must be replaced.

b. Measure all of the journals at several places on the circumference to determine smallest diameter. Taper and out-of-round on the journals must exceed 0.003 inch.

c. Remove slight ridges on journals with 120 grit emery cloth followed by 240 grit. Use crocus cloth wet with fuel oil to polish the surface. Rotate the crankshaft to avoid out-of-round condition. If ridging is too severe to remove in this manner, replace the crankshaft.

d. Inspect the surfaces for cracks.

(1) Magnetize the crankshaft and cover with fine magnetic powder. Cracks will cause particles to gather, marking the crack. Demagnetize the crankshaft after the test.

(2) The indications found are often harmless, however certain areas usually require crankshaft replacement (fig. 3-72).

(3) If crankshaft required replacement, check for contributory causes to avoid repetition.

e. Check thrust surfaces for excessive wear or roughness. Dress with crocus cloth wet with fuel oil.

f. Inspect the keyways for cracks or wear. Replace crankshaft if required.

g. Inspect crankshaft in the area of rear oil seal contact surface for grooves or roughness. Remove slight ridges with 120 and 240 grit emery cloth. Polish with crocus cloth. If defect is excessive, the use of an oil seal spacer between the oil seal and the counterbore in the flywheel housing may provide the needed contact surface. A double-lip type oil seal cannot be used with this application.

h. Inspect the bearing shells. Refer to paragraph 3-166.

i. Check crankshaft and bearing dimensions (table 1-1).

3-161. Reassembly

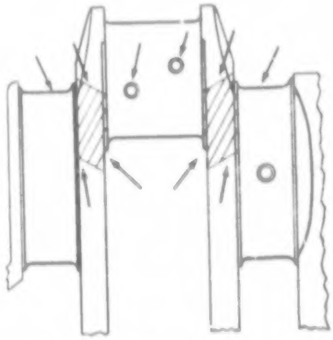
a. Replace the timing gear as follows:

(1) Place gear (19, fig. 3-71) on crankshaft (15). Notice that one bolt hole is offset so that only one mounting position is possible.

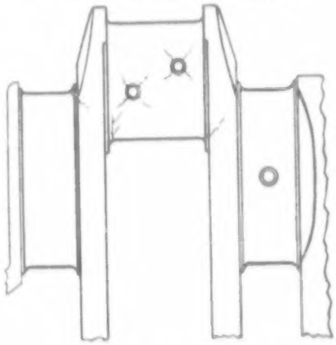
(2) Install bolts (18) and tighten to 35-39 foot-pounds torque.

b. Replace Woodruff key (22) and oil pump drive gear (20).

c. Install the upper bearing shells (17), which are grooved, in the cylinder block.



CRITICAL LOADING ZONES



TYPICAL FATIGUE CRACKS

MEC 3805-240-35/3-72

Figure 3-72. Crankshaft loading zones and typical fatigue cracks.

3-162. Installation

a. Apply clean engine oil to all crankshaft journals and set crankshaft in place so that the timing gear and the idler gear match (fig. 3-65).

b. Install the upper halves of the thrust washers (13, fig. 3-71) on each side of bearing and the doweled lower haves on each side of main bearing cap (11).

Caution: **The grooved side of the thrust washers must face toward the crankshaft thrust surfaces.**

c. With lower bearing shells (12) installed in the bearing caps (11), lubricate bolt threads and heads with SAE 30 engine oil and install bolts (9) and washers (10). Draw up snug. Rap the caps sharply with a soft hammer to seat them properly. Tighten bolts to 180-190 foot-pounds torque.

Note. If bearings are installed properly, the crankshaft should turn freely.

d. Check crankshaft end play by moving the crankshaft toward the dial indicator (fig. 3-73). Keep pressure on tool and set dial indicator to zero. Remove screw driver and insert on other side of cap. Force the screw driver in the opposite direction and note end play reading on dial. The end play on new parts shall be 0.004—0.011 inch, and a maximum of 0.018 inch with used parts. Check rear main bearing alinement and the thrust washers if end play is less than 0.004 inch.

e. Lubricate and install connecting rod bearings. Refer to paragraph 3-104. Lock bearing caps in place with nuts and bolts tightened to 65-75 torque.

f. Install the key (4), spacer (21), slinger (8) and the front oil seal (7, fig 3-71).

g. Replace flywheel housing and flywheel. See paragraphs 3-117 and 3-123.

h. Replace the crankshaft front cover. Refer to paragraph 3-155.

i. Install front crankshaft pulley (3). Install end bolt (1) and washer (2). Tighten bolt to 190 foot-pounds torque. Strike with 2-3 pound lead hammer. Then tighten to 300 foot-pounds torque.

j. Replace the oil pan gasket and secure oil pan with bolts and lockwashers. Tighten bolts to 15-20 foot-pounds torque.

k. Replace all accessories remove from engine.

l. Reinstall the torque converter (para 2-40).

m. Refill the engine crankcase.

n. Fill the cooling system.

o. Replace engine and torque converter assembly in vehicle (para 2-41).

p. If bearings on crankshaft were replaced, operate the engine on the run-in schedule (para 33-196 and table 3-1). Check for leaks.

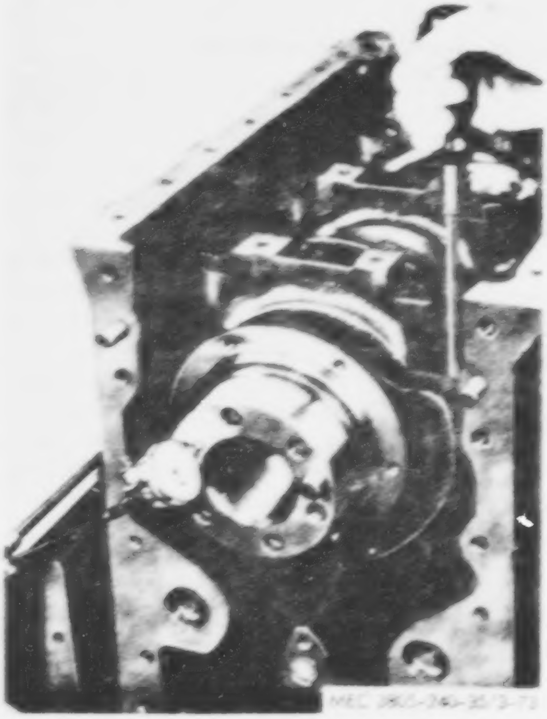

MEC 3805-240-35/3-73

Figure 3-73. Checking crankshaft end play.

Section XXV. MAIN BEARINGS

3-163. General

a. The main bearing shells are of the precision type and are readily replaceable without machining. They consist of an upper shell seated in each cylinder block main bearing support and a lower shell seated in each main bearing cap. The bearing shells are prevented from endwise or radial movement by a tang at the parting line at one end of each shell.

b. An oil hole in the groove of each upper shell, midway between the parting lines, registers with a vertical oil passage in the cylinder block. Lubricating oil, under pressure, passes from the cylinder block by way of the bearing shells to the drilled passages in the crankshaft, then to the connecting rods and connecting rod bearings. The lower main bearing shells have no oil grooves; therefore, the upper and lower bearing shells must not be interchanged.

c. Crankshaft thrust washers, at each side of the rear main bearing, absorb the crankshaft thrust. The lower halves of the two-piece washers are doweled to the bearing cap, the upper halves are not doweled.

d. The crankshaft main bearings were removed in the complete overhaul procedure for the crankshaft (para 3-157). The procedure for removal and service of the main bearings only, with the crankshaft in place in the engine will be covered in this paragraph.

3-164. Removal

a. Perform operation *a* through *k* as described in paragraph 3-79.

b. Remove one bearing cap (fig. 3-71) at a time. See figure 3-74. Inspect, clean and reassemble bearing shells and reinstall bearing caps before removing another bearing cap.

c. To remove bearing shells (except the rear main bearing shell), proceed as follows:

(1) Insert a 5/16 x 1 inch long bolt with a 1/2 inch diameter and a 1/16 inch thick head (make from a standard bolt) into the crankshaft journal oil hole.

(2) Revolve crankshaft to the right and roll bearing shell out of position (fig. 3-75). The head of the bolts must not extend beyond the outside diameter of the shell.

d. To remove rear main bearing shell proceed as follows:

(1) Drive on the edge of the bearing shell with a small curved rod, simultaneously revolving the crankshaft to roll the shell from its position (fig. 3-76)

(2) The lower halves of the thrust washers will be removed along with the rear main bearing cap. The upper halves of the washers (fig. 3-71) can be removed by pushing on the ends of the washers with a small rod to force them around and out of bearing support.

3-165. Cleaning

Clean bearing shells with solvent. Dry with compressed air.

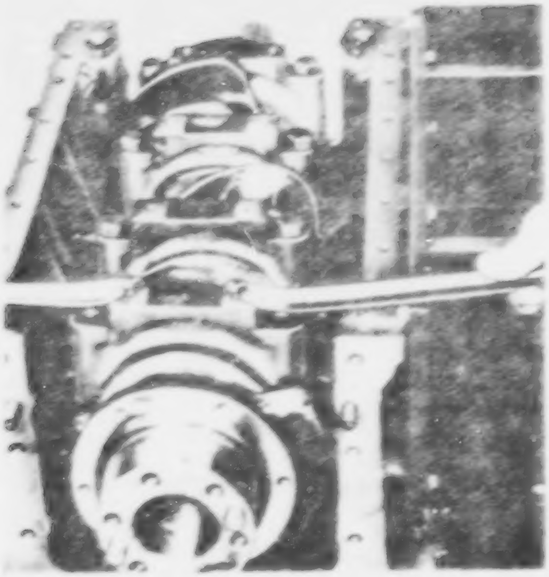


Figure 3-74. Main bearing cap removal.

3-166. Inspection and Repair

a. Inspect bearings for scoring, pitting, flaking, etching and grooving. If any of these conditions are present, replace the bearings. (fig. 3-77).

b. Inspect the backs of the bearing shells for bright spots which indicate movement in the caps or cylinder block. If spots are present, replace the bearing shells.

c. Measure the thickness of the shells with micrometer ball attachment and micrometer (fig. 3-78) at point 90° from the parting line. The bearing shell thickness will be the total thickness of the ball in the tool and the shell less the ball diameter. Minimum allowable thickness of shell is 0.154 inch. If any shells are thinner than this dimension, replace all of the shells.

d. Check clearance between the main bearings and the crankshaft journals.

(1) Use commercially manufactured plastic measuring tape.

(2) Remove the bearing cap and wipe oil from the shell and crankshaft journal.

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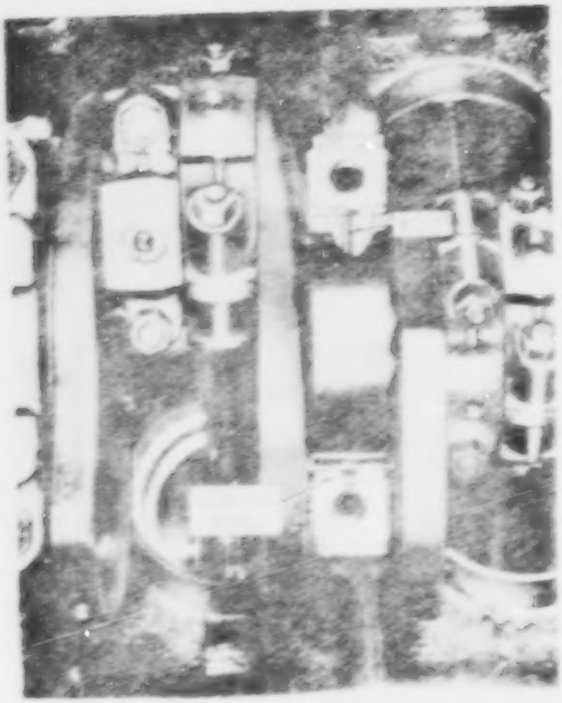


Figure 3-75. Main bearing shell removal.

(3) Be sure weight of engine does not affect readings by properly supporting weight of crankshaft.

(4) Place a piece of plastic strip the full width of shell about 1/4 inch off center (fig. 3-79).

(5) Rotate the crankshaft about 30° from bottom dead center and reinstall the bearing cap. Tighten the bolts to 180–190 foot-pounds torque.

(6) Remove the bearing cap. The flattened strip will adhere to either the bearing shell or the crankshaft.

(7) Compare width of strip at its widest point with graduations in the envelope. Number within the graduation on the envelope indicates the bearing clearance in thousandths of an inch. Use median reading if flattened tape varies in width.

e. If clearance of any of the shells exceeds 0.006 inch replace all of the shells. New bearing clearance is 0.0016—.0041 inch.

f. Inspect the crankshaft journals. The inspection procedures are covered in paragraph 3-160. Check end play as outlined in paragraph 3-162.

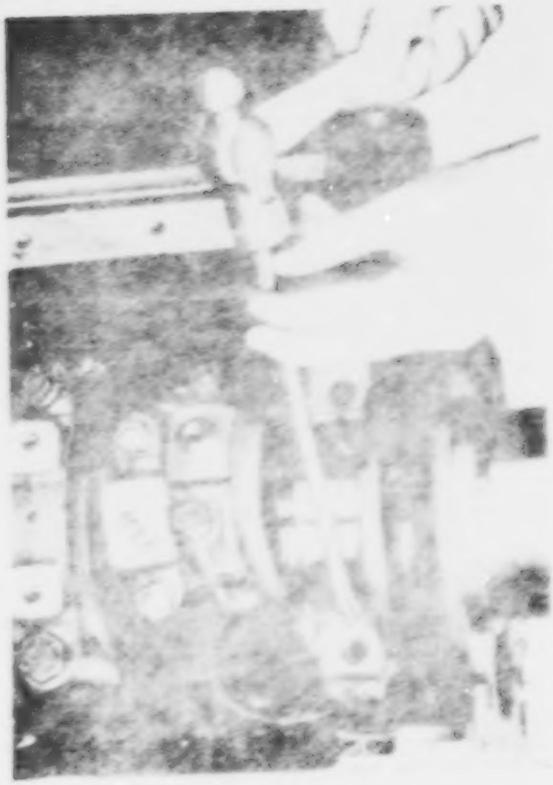


Figure 3-76. Rear main bearing shell removal.

g. Clean bearing caps, thrust washers and hardware. Inspect for wear or damage. Replace as required.

3-167. Reassembly

a. Apply clean engine oil to each crankshaft journal as bearing shells are installed.

b. Start the plain end of the upper shell around the journal. When shell is in place the tang will fit into the groove in the bearing support.

***Caution:* The upper bearing shells are grooved and drilled for lubrication. The bottom shells are not. Do not reverse their positions. Used bearing shells must be reinstalled on the same journals from which they were removed.**

c. Assemble the thrust washers before installing the rear main bearing cap. Slide the upper halves into place in their grooves. Assemble the lower halves over the dowel pins in the bearing cap.

***Caution:* The main bearing caps are bored in position and marked 1, 2, 3, etc. They must be replaced in their original positions.**

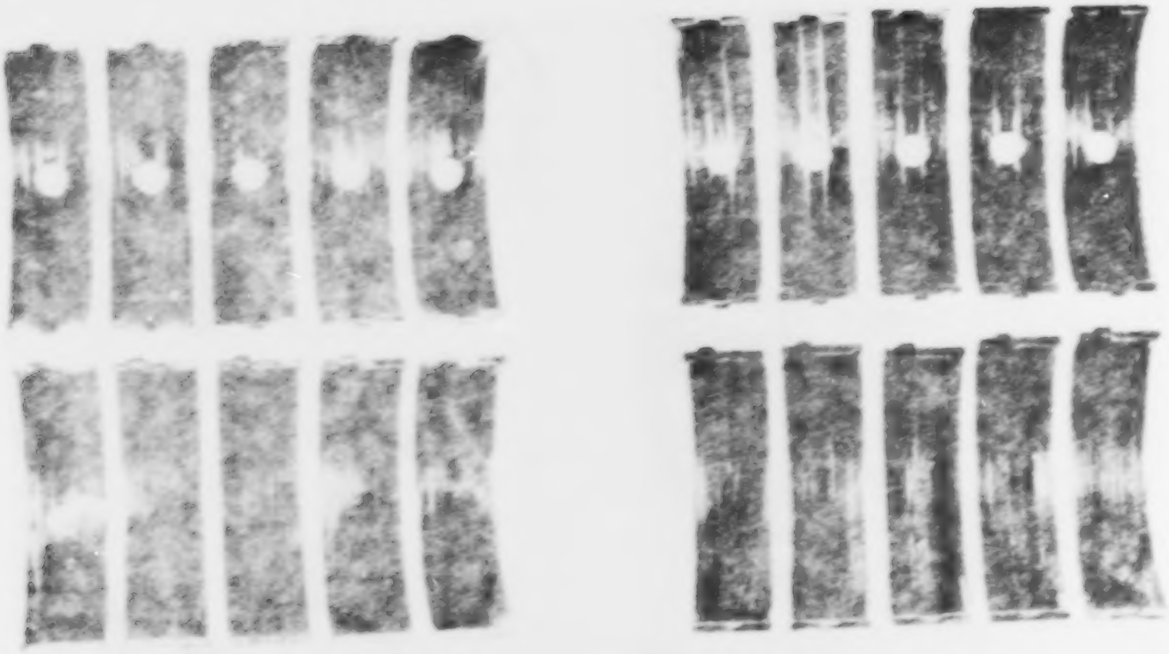


Figure 3-77. Comparison of main bearing shells.

3-168. Installation

a. Install the lower bearing shells in the bearing caps. Lubricate the threads on bolt head contact areas with SAE 30 engine oil.

b. Install the bearing caps and draw bolts up snug. Rap the caps sharply with a soft hammer to seat them properly. Draw the bolts tight to 180—190 foot-pounds torque.

c. Ensure that the crankshaft turns freely and check the end play. Refer to paragraph 3-162.

d. Replace oil pan gasket and oil pan

e. Replace all accessories removed from engine to enable mounting in overhaul stand.

f. Replace the torque converter (para 2-40).

g. Fill the cooling system.

h. Fill the crankcase to proper level.

i. Replace engine (para 2-40). See paragraph 3-196 and table 3-1 for operation after overhaul if bearings were replaced.

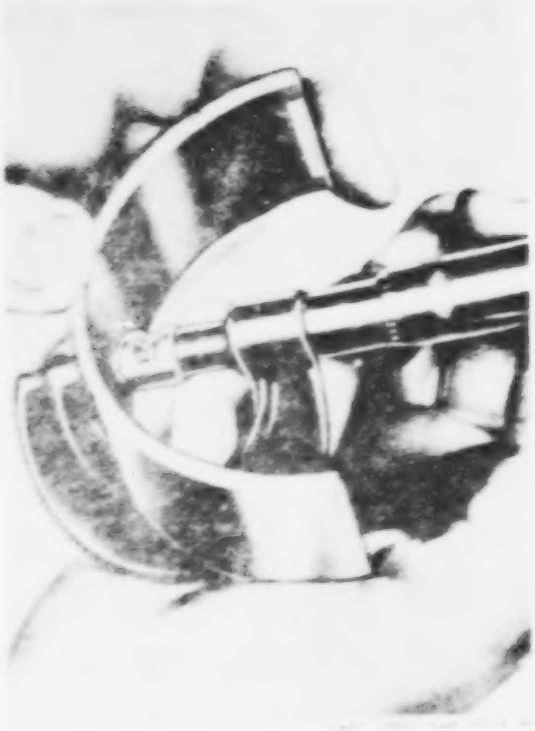
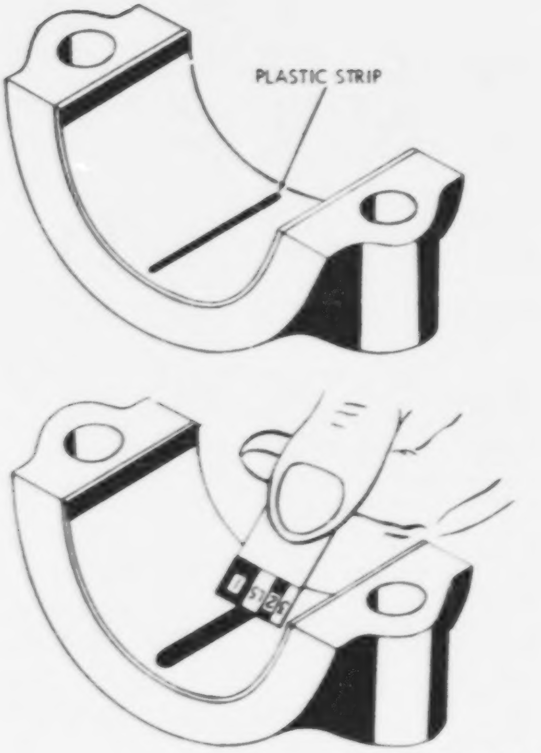


Figure 3-78. Measuring bearing shell thickness.



MEC 3805-240-35/3-79

Figure 3-79. Checking bearing shell clearance with plastic strip.

Section XXVI. FUEL INJECTOR TUBES

3-169. General

The bore in the cylinder head for the fuel injector is directly through the cylinder head water jacket. To prevent coolant from contacting the injector and still maintain maximum cooling of the injector, a tube is pressed into the cylinder head. This tube is sealed at the top with a neoprene ring and upset into a flare on the lower side of the cylinder head to create water-tight joints at the top and bottom.

3-170. Removal

a. Remove and disassemble cylinder head (sec. XI).

b. Support the cylinder head on its side with the exhaust port side down.

c. Place the injector tube installer injector tube. Insert the pilot through the small opening of injector tube and thread pilot into tapped hole in end of installer.

d. Tap on end of pilot with a ball peen hammer and loosen the injector tube. Then, lift the injector tube, installer and pilot from the cylinder head.

3-171. Cleaning

Thoroughly clean the injector tube hole in the cylinder head of dirt, burrs, or foreign material that may prevent the tube from sealing at the lower end or sealing at the upper end.

3-172. Inspection and Repair

Injector tubes must be discarded after removal and replaced with new tubes.

3-173. Installation

a. Place injector tube sealing ring in cylinder head injector tube counterbore.

b. Place injector tube installer in injector tube, insert pilot through the small opening of injector tube and thread pilot into tapped end of installer.

c. Slip the injector tube into injector bore and drive into place using a ball peen hammer. The flange at upper end of tube will seat on the seal ring and into the counterbore of cylinder head when the injector tube is properly positioned.

d. With the injector tube properly positioned in cylinder head, upset (flare) lower end of injector tube, as follows:

(1) Turn cylinder head bottom side up, remove pilot and thread upsetting die into tapped end of injector tube installer (fig. 3-80).

(2) Then, using a socket and torque wrench, apply approximately 30 foot-pounds torque on upsetting die.

(3) Remove injector tube installing tools and ream the injector tube as outlined below.

e. After an injector tube has been installed in a cylinder head, it must be finished in three operations: First, *hand reamed* to receive injector body nut and spray tip; second, *spot-faced* to remove excess stock at the lower end of injector tube; and third, *hand reamed* to provide a good seating surface for the bevel or the lower end of the injector nut. Reaming must be done carefully and without undue force or speed so as to avoid cutting through the thin wall of the injector tube. The reamer should be turned in a *clockwise direction* only, both when inserting and when withdrawing the reamer because movement in the opposite direction will dull the (sharpened) cutting edges of the flutes.

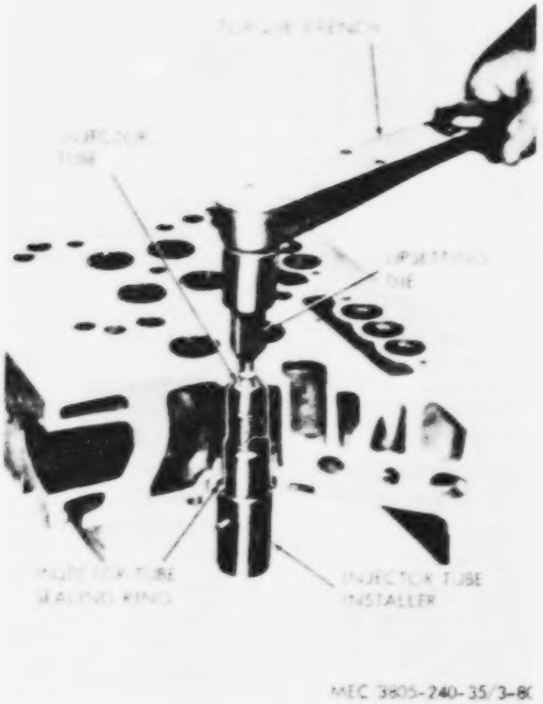


Figure 3-80. Upsetting injector tube.

(1) Ream injector tube for injector nut and spray tip. With cylinder head right side up and injector tube free from dirt, proceed with the first reaming operation as follows:

(*a*) Place a few drops of light cutting oil on reamer flutes, then carefully position body and tip reamer in the injector tube.

(*b*) Turning reamer in clockwise direction, continue the reaming operation (withdrawing reamer frequently for removal of chips) until the lower shoulder of reamer contacts injector tube. Clean out all chips.

(2) Remove excess stock.

(*a*) With cylinder head bottom side up, insert pilot of cutting tool into small hole of injector tube.

(*b*) Then, using a socket and speed handle, remove excess stock so that the lower end of injector tube is from flush to 0.005 inch below the finished surface of the cylinder head.

(3) Ream bevel seat in injector tube. The tapered lower end of the injector tube must provide a smooth and sure seat for the lower end of the injector nut to effectively seal the cylinder pressures and properly position the injector tip into the combustion chamber. Therefore, to determine the amount of stock that must be reamed from the bevel seat of tube, the injector assembly should be installed in the tube and the relationship between the numbered surface of the spray tip to the fire deck of the cylinder head noted. With the first reaming operation completed and the injector tube spot-faced, wash interior of injector tube with trichloroethylene or clean fuel oil and dry with compressed air. Then perform the second reaming operation as follows:

Caution: **Service replacement injector tubes are semifinished and have a narrow land machined at the beveled seat to reduce reaming time. Extreme care must be exercised while reaming the bevel seat to prevent reamer from cutting too deeply and possibly through the thin wall of the tube.**

(*a*) Place a few drops of cutting oil on bevel seat of tube. Carefully set injector nut reamer into injector tube until it contacts the bevel seat.

(*b*) Make a trial cut by turning the reamer steadily without applying any downward force on the reamer. Remove the reamer, blow out the chips, and look at the bevel seat to see what portion of the seat has been cut.

(*c*) Proceed carefully with the reaming operation, withdrawing the reamer occasionally to observe the reaming progress.

(*d*) Remove chips from injector tube and, using an injector as a gage, continue the reaming operation until the shoulder of the spray tip is from flush to 0.015 inch below the fire deck of the cylinder head.

Section XXVII. FUEL INJECTORS

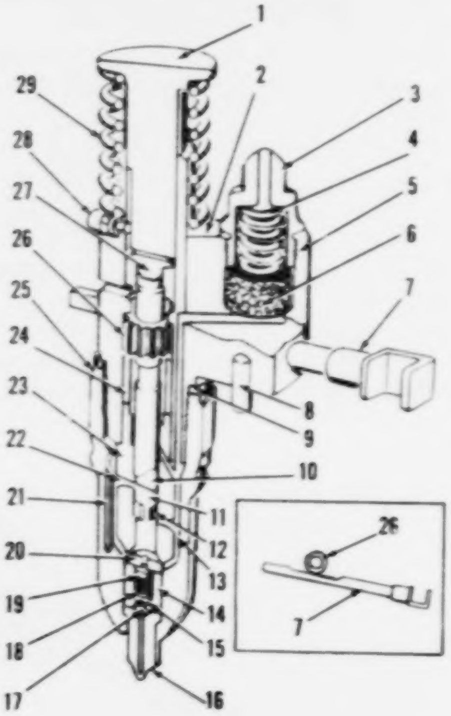
3-174. General

a. The unit fuel injector (fig. 3-81) is one of the most important and precisely built parts of the engine. The injection of the correct amount of fuel into the combustion chamber at exactly the right time depends upon this unit. Because the injector operates against the high compression pressure in the combustion chamber, efficient operation demands that the injector assembly is maintained in first-class condition at all times.

b. Proper maintenance of the fuel system and the use of the recommended type fuel filters and clean water-free fuel are the keys to trouble-free operation of the injectors.

c. Servicing an injector is not a difficult task and may be performed by the average serviceman. However, due to the close tolerance of the various injector parts, extreme cleanliness and strict adherence to service instructions is required.

d. Each fuel injector is identified by a circular tag pressed into a recess in the injector body (fig. 3-82). The number on the tag indicates the nominal fuel output of the injector in cubic millimeters. The numbers stamped on the plungers and spray tips aid in the assembly of the correct parts when reconditioning the injectors.



MEC 3805-240-35/3-81

1	Follower	16	Spray tip
2	Injector body	17	Check valve
3	Filter cap	18	Spring
4	Spring	19	Injector valve
5	Gasket	20	Valve seat
6	Filter	21	Spill deflector
7	Control rack	22	Upper port
8	Dowel pin	23	Bushing
9	Seal	24	Gear retainer
10	Upper helix	25	Nut
11	Lower helix	26	Gear
12	Fuel metering recess	27	Plunger
13	Lower port	28	Stop pin
14	Valve cage	29	Follower spring
15	Valve stop		

Figure 3-81. Fuel injector assembly, cutaway view.

3-175. Removal

Refer to TM 5-3805-240-12 and remove the valve rocker covers.

a. Remove the fuel pipes from both the injector and the fuel connectors (1 and 2, fig. 3-13).

b. Install clean shipping caps on the injector fuel inlet and outlet and on the fuel connectors. Also protect the fuel pipes and fuel connectors from the entry of dirt or other foreign material.

c. Crank the engine to bring the outer ends of the push rods of the injector and valve rocker arms in line horizontally (fig. 3-83).

d. Remove the two rocker shaft bracket bolts and swing the rocker arms away from the injector and valves (fig. 3-84).

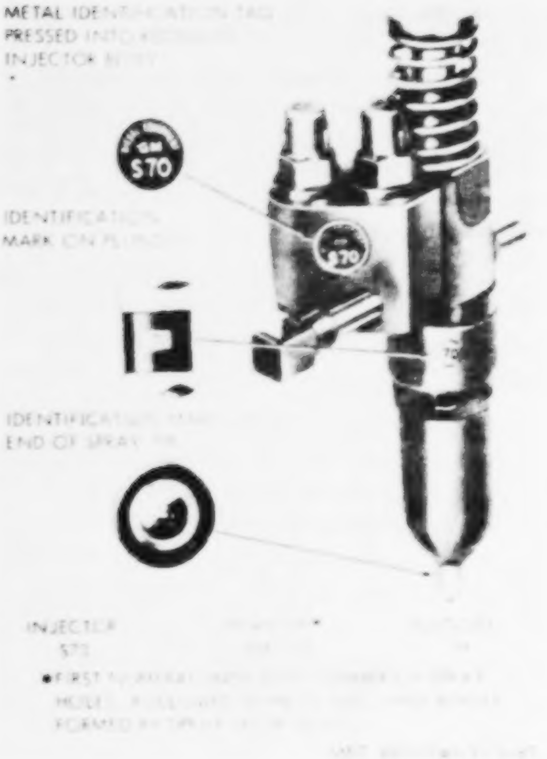

METAL IDENTIFICATION TAG
PRESSED INTO RECESS IN
INJECTOR BODY
S70
IDENTIFICATION
MARK ON PLUNGER
IDENTIFICATION MARK ON
END OF SPRAY TIP
INJECTOR
S70

Figure 3-82. Injector identification chart.

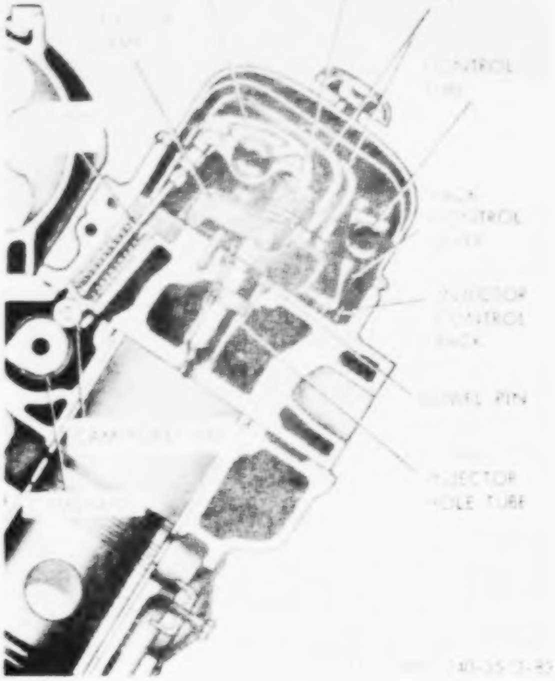

CONTROL
TUBE
RACK
CONTROL
LEVER
INJECTOR
CONTROL
RACK
DOWEL PIN
CAM FOLLOWER
INJECTOR
HOLE TUBE

Figure 3-83. Fuel injector mounting, cross-section.

e. Remove the injector clamp bolt, special washer, and clamp (3, 4 and 5, fig. 3-13).

f. Loosen the inner and outer adjusting screws (20) on the injector rack control lever (21) and slide the lever away from the injector.

g. Lift the injector from its seat in the cylinder head as shown in figure 3-84.

h. Cover the injector hole in the cylinder head to keep foreign material out.

i. Clean the exterior of the injector with fuel oil and dry it with compressed air.

3-176. Bench Testing

a. General.

(1) If inspection does not reveal any external damage, then perform a series of tests to determine the condition of the injector to avoid unnecessary overhauling.

(2) If there is any suspicion that a fuel injector is "out of time", the injector rack-to-gear timing may be checked without disassembling the injector. A hole located in the injector body, on the side opposite the identification tag, may be used to visually determine whether or not the injector rack and gear are correctly timed. When the rack is all the way in the (FULL FUEL position), the flat side of the plunger will be visible in the hole, indicating that the injector is "in time". If the flat side of plunger does not come into full view and appears in the "advanced" or "retarded" position, the injector should be disassembled and the rack-to-gear timing corrected.

(3) An injector that passes all of the tests outlined below may be considered to be satisfactory for service without disassembly, except for the visual check of the plunger.

(4) An injector that fails to pass one or more of the tests is unsatisfactory. Perfrom all of the tests before disassembling an injector to correct any one condition.

(5) Identify each injector and record the pressure drop and fuel output as indicated by the following tests.

b. Injector Control Rack and Plunger Movement Test.

(1) Check to see if the plunger works freely in its bushing and whether the control rack moves back and forth freely.

(2) Place the injector in the injector tester (fig. 3-85) with the dowel in the underside of

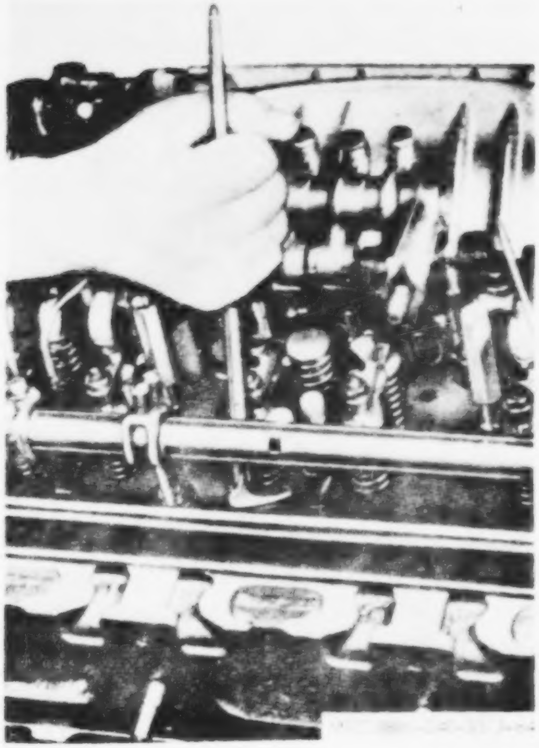


Figure 3-84. Removing fuel injector from cylinder head.

the injector located in the proper slot or hole in the adaptor plate. Position the handle support to the proper height.

(3) Place the handle on top of the injector follower then close the inlet and outlet clamps to hold the injector in the tester. With the injector control rack held in the NO FUEL position, push the handle down and depress the follower to the bottom of its stroke.

(4) Very slowly release the pressure on the handle while moving the control rack back and forth, as shown in figure 3-85, until the follower reaches the top of its travel. If the rack does not move freely it indicates that the internal parts of the injector are damaged or dirty.

c. Valve Opening Pressure Test.

(1) The purpose of the valve opening pressure test is to determine the pressure at which the valve opens and injection begins.

(2) Place the injector in the tester (fig. 3-86) with the dowel on the underside of the injector located in the proper slot of the adaptor plate.

(3) Position the injector handle support to the proper height.

Note. Before using the injector tester, or when refilling it with fuel oil, disconnect the tube at the gage and pump the handle until all of the air is expelled from the system. Then, reconnect the tube to the gage.

Warning: **Always place the injector in the proper position in relation to the spray deflector before it is tested, in order to prevent the fuel spray from penetrating the skin. Fuel oil which enters the blood stream can cause a serious infection.**

(4) Close the inlet clamp. Operate the pump handle until all of the air is purged from the injector tester and the injector. Then close the outlet clamp.

(5) With the injector rack in the FULL FUEL position, pump the handle of the injector tester with smooth, even strokes (fig. 3-87) and record the injector valve opening pressure indicated when the injector sprays fuel. The specified valve opening pressure is 450 to 850 psi. If the pressure is not within the above range, see trouble shooting chart, paragraphs 2-6, 2-9.

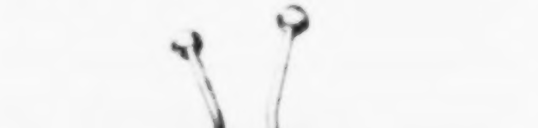


Figure 3-85. Checking rack and plunger for free movement.

d. Valve Holding Pressure Test.

(1) The valve holding pressure test will determine whether the various lapped surfaces in the injector are sealing properly.

(2) Operate the pump handle to bring the pressure up to a point just below the injector valve opening pressure.

(3) Close the fuel shut-off valve and note the pressure drop. The time for a pressure drop from 450 psi to 250 psi must not be less than 40 seconds.

(4) If the injector pressure drops from 450 psi to 250 psi in less than 40 seconds, check the injector as follows:

(*a*) Thoroughly dry the injector with compressed air.

(*b*) Open the injector tester fuel valve and operate the pump handle to maintain the test pressure.

(*c*) Check for a leak at the injector rack opening. A leak indicates a poor bushing-to-body fit.

(*d*) A leak around the spray tip or seal ring usually is caused by a loose injector nut, a damaged seal ring, or a brinelled surface on the injector nut or spray tip.

(*e*) A leak at the filter cap indicates a loose filter cap or damaged filter cap gasket.

(*f*) A "dribble" at the spray tip orifice indicates a leaking valve assembly due to a damaged surface or dirt. Leakage at the tip will cause pre-ignition in the engine.

Note. A drop or two of fuel at the spray tip is only an indication of the fuel trapped in the spray tip at the beginning of the test and is not detrimental as long as the pressure drop specified is not less than 40 seconds.

e. High Pressure Test.

(1) This test is performed to discover any fuel leaks at the injector filter caps, body plugs, nut seal ring, and internal lapped surfaces which did not appear during the valve holding pressure test.

(2) The high pressure test also indicates whether or not the plunger and bushing clearances are satisfactory.

(*a*) Thoroughly dry the injector with compressed air.

(*b*) Check the fuel connections for leaks. If leaks have occurred, tighten the connections, dry the injector and recheck.

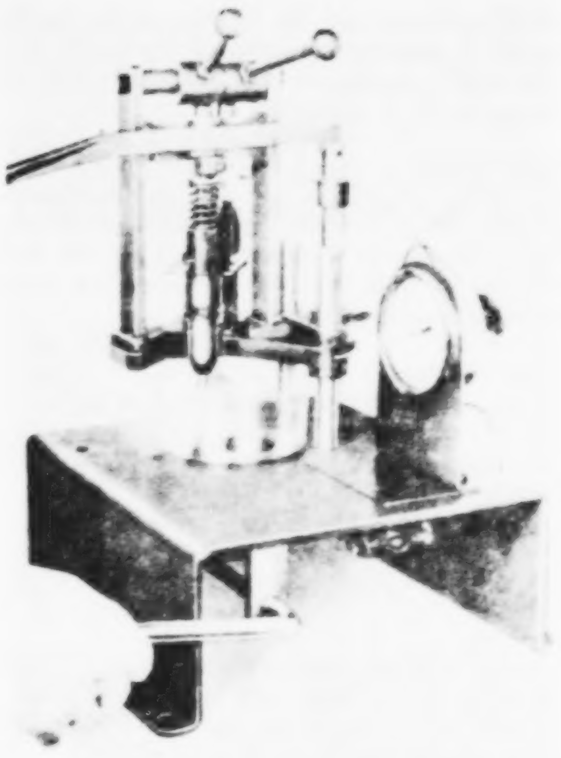


Figure 3–87. Checking injector valve opening pressure.

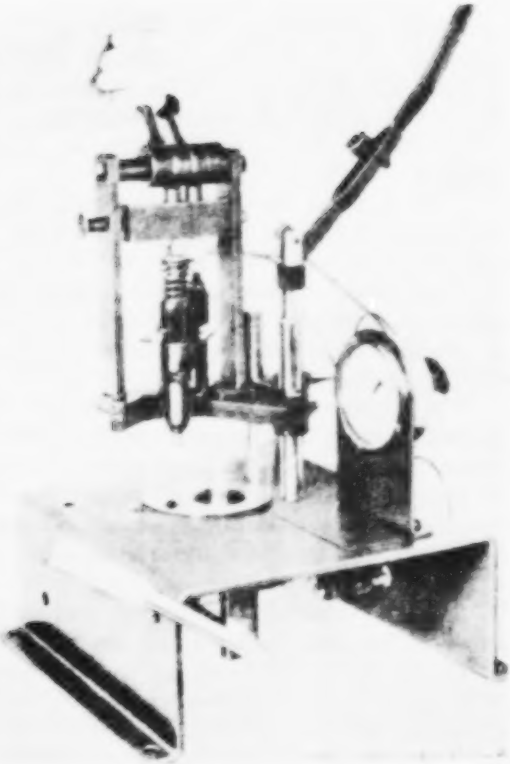


Figure 3–86. Installing injector in injector tester.

(*c*) With the injector rack in the FULL FUEL position and the injector tester handle locked in position by means of the handle lock (fig. 3-88), operate the pump handle to build up and maintain the pressure.

(3) Use the adjusting screw in the injector tester handle to depress the injector plunger just far enough to close both ports in the injector bushing. The point at which both ports are closed may be easily ascertained by the fact that the injector spray will decrease appreciably and a rise in pressure will occur.

(4) At this time, the condition of the plunger and bushing may be established. If there is excessive clearance between the plunger and bushing, pressure beyond the normal valve opening pressure cannot be obtained. Replacement of the injector assembly is then required.

(5) After performing the above inspection checks and with the injector in the same position in the test fixture, slowly move the pump handle up and down to maintain a pressure of 1600 to 2000 psi.

(6) While maintaining this pressure, inspect the filter cap gaskets, body plugs, and injector nut seal ring area. If leakage occurs at any of these points, it indicates that the parts are not tightened to the torque specification or that the parts are damaged and must be replaced. Some fuel leakage will occur at the rack hole in the body during test. This is to be expected. It is due to high pressure fuel being applied to a normally low pressure area in the injector assembly.

***Caution:* Do not permit the pressure in the injector tester to equal or exceed the capacity of the pressure gage.**

f. Spray Pattern Test.

(1) With the injector rack in the FULL FUEL position, operate the pump handle to maintain a fuel pressure just below the valve opening pressure.

(2) Operate the injector several times with the pump handle and observe the spray pattern emitted from the spray tip orifices. Fuel should be discharged from each orifice and the spray should produce a uniform pattern.

(3) If the spray tip does not produce a uniform pattern, clean the orifices in the spray tip during injector overhaul.

g. Visual Inspection of Plunger.

(1) An injector which passes all of the previous tests should have the plunger checked visually, under a magnifying glass, for excessive wear or a possible chip on the bottom helix. There is a small area on the bottom helix and lower portion of the upper helix, if chipped, that will not be indicated in any of the tests.

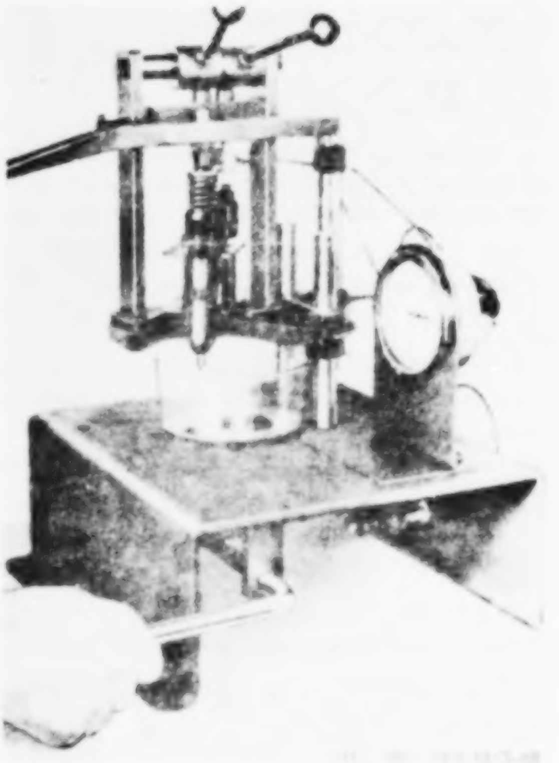


Figure 3-88. Injector high pressure test.

(2) Remove the plunger from the injector as follows:

(*a*) Support the injector, right side up, in holding fixture (fig. 3-89), or in injector vise jaws.

(*b*) Compress the follower spring. Then, using a screwdriver, raise the spring above the stop pin and withdraw the pin. Allow the spring to rise gradually.

(*c*) Remove the injector from the holding fixture. Turn the injector upside down, to prevent the entry of dirt, and catch the spring and plunger as they drop out.

(*d*) Inspect the plunger and, if chipped (fig. 3-90), replace the injector assembly.

h. Fuel Output Test.

(1) The injector fuel output test is performed in the comparator.

(2) Make sure the counter on the comparator is preset to 1000 strokes. If, for any reason, this setting has been altered, raise the cover and reset the counter to 1000 strokes by pulling the

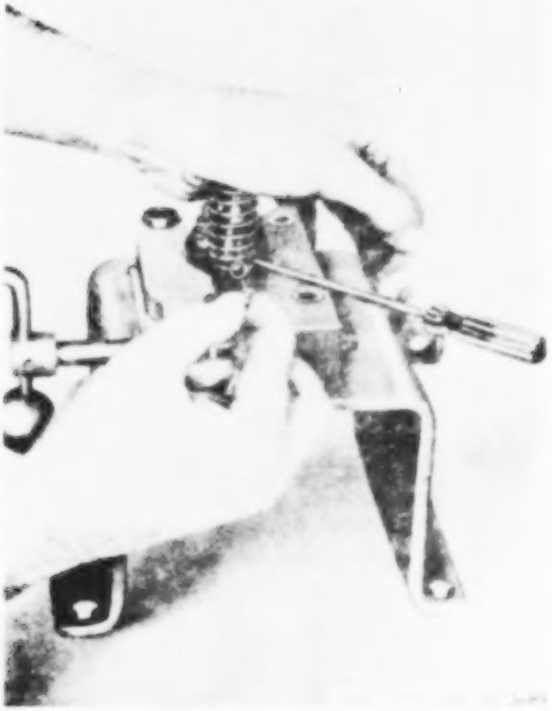


Figure 3-89. Removing injector follower stop pin.

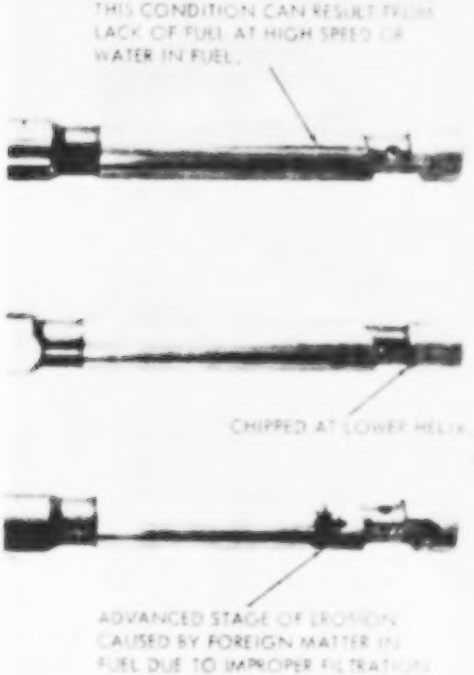

THIS CONDITION CAN RESULT FROM LACK OF FUEL AT HIGH SPEED OR WATER IN FUEL.
CHIPPED AT LOWER HELIX.
ADVANCED STAGE OF EROSION CAUSED BY FOREIGN MATTER IN FUEL DUE TO IMPROPER FILTRATION.

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Figure 3-90. Unusable injector plungers.

selector wheel to be changed to the right and rotating it to its proper setting (fig. 3-91). Then, release the wheel and close the cover. Refer to the comparator instruction booklet for further information.

(3) When injectors are removed from an engine for output testing and, if satisfactory, reinstalled without disassembly, extreme care should be taken to avoid reversing the fuel flow. Note the direction of fuel flow through the injector before removing it from the engine. When the fuel flow is reversed, dirt trapped by the filter element is back-flushed into the injector components. To avoid reversing the fuel flow when checking injector fuel output on the comparator use the appropriate adaptor. The position of the fuel flow pipes shown in figure 3-92 depends on the adaptor being used and the direction of fuel flow through the injectors.

Note. The fuel passages in some adaptors are drilled straight through; others are cross drilled.

(4) To check the fuel output operate the injector in the comparator as follows (fig. 3-93).

(*a*) Place the injector in the comparator and tighten the hand wheel to seal it firmly.

(*b*) Pull the injector rack out to the NO FUEL position.

(*c*) Start the comparator.

(*d*) After the comparator has started, push the injector rack to the FULL FUEL position.

(*e*) Let the injector run for approximately 30 seconds to purge the air that may be in the system.

(*f*) After 30 seconds, press the fuel flow start button. This will start the flow of fuel into the vial. The comparator will automatically stop the flow of fuel after 1000 strokes.

(*g*) After the fuel stops flowing into the vial, pull the injector rack out to the NO FUEL position.

(*h*) Turn the comparator off and reset the counter.

(*i*) Observe the reading on the vial. The quantity of fuel in the vial should fall within 30 to 36.

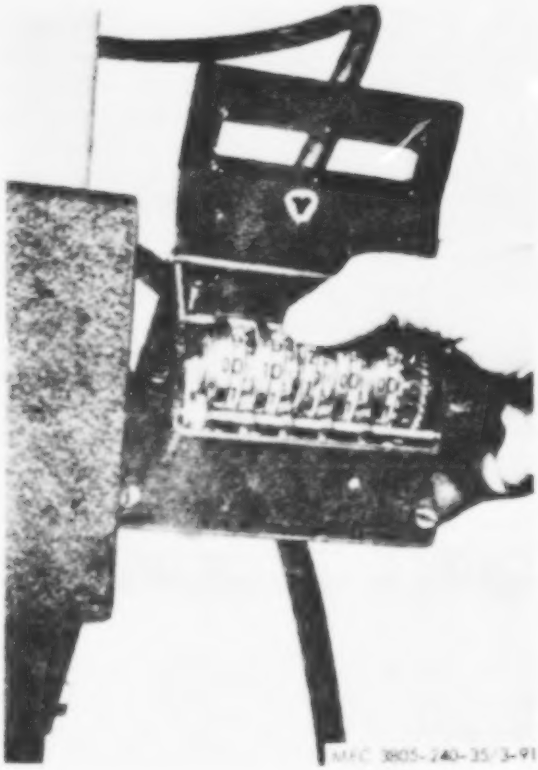


Figure 3-91. Setting comparator stroke counter.

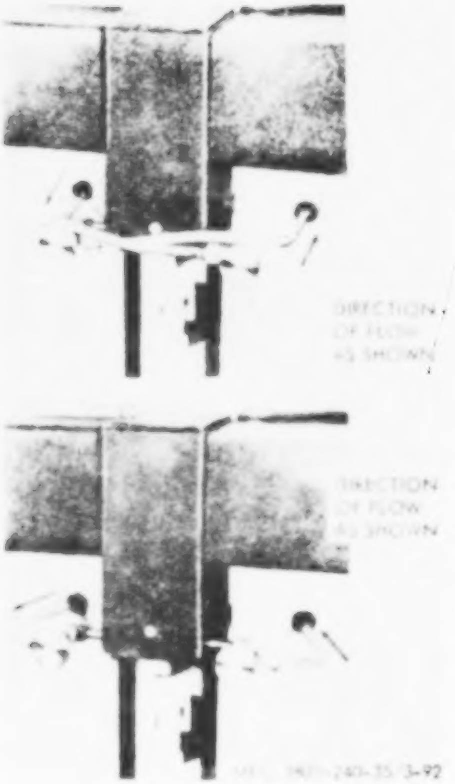


Figure 3-92. Position of fuel flow pipes.

(5) Several factors affect the injector comparator output readings. The four major items are:

(*a*) *Operator error.* If the column of liquid in the vial is read at the top of the meniscus instead of at the bottom, a variation of 1 or 2 points will result.

(*b*) *Air in lines.* This can be caused by starting a test before the air is purged from the injector and lines, or from an air leak on the vacuum side of the pump.

(*c*) *Counter improperly set.* The counter is set to divert the injector output at 1,000 strokes at the factory. It is possible that in returning to the 1,000 stroke setting, an error could be made. (This should not be confused with counter overrun that will vary from 2 to 6 digits depending upon internal friction. The fuel diversion is accomplished electrically and will occur at 1,000 strokes (if properly set) although the counter may overrun several digits.)

(*d*) *Test oil.* A special test oil is supplied with the comparator and should always be used. If regular diesel fuel oil (or any other liquid) is used, variations are usually noted because of the affect of the oil on the solenoid valve and other parts.

(6) In addition, other malfunctions such as a slipping drive belt, low level of fuel oil, a clogged filter, a defective pump and leaking line connections all could cause bad readings. A frequent check should be made for any of these tell-tale conditions. The comparator may be used to check and select a set of injectors which will inject the same amount of fuel in each cylinder at a given throttle setting, thus resulting in a smooth running, well balanced engine.

3-177. Disassembly

a. Support the injector upright in the injector assembly fixture (fig. 3-94) and remove the filter caps, springs, filter elements, and gaskets.

Note. Whenever a fuel injector is disassembled, discard the filter elements and gaskets and replace them with new filters and gaskets. After an injector has been operated in an engine, do not remove the filter caps or filters while the injector is in engine. Replace the filters only at the time of complete disassembly and assembly of an injector.

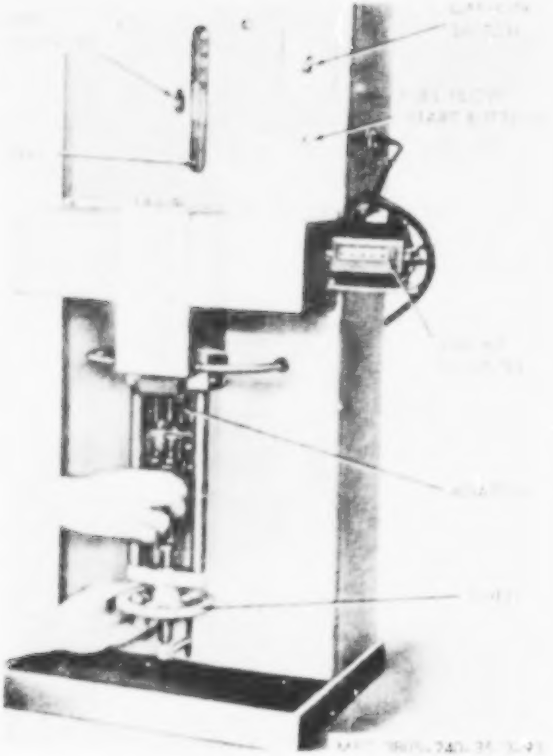


Figure 3–93. Installing injector in comparator.

b. Compress the follower spring as shown in figure 3–89. Then, using a screw driver, raise the spring above the stop pin and withdraw the pin. Allow the spring to rise gradually.

c. Refer to figure 3–95 and remove the plunger follower, spring, and plungers as an assembly.

d. Reverse the injector in the fixture and, using socket wrench, loosen the nut on the injector body (fig. 3–96).

e. Lift the injector nut straight up by hand, being careful not to dislodge the spray tip and valve parts. Remove the spray tip and valve parts from the bushing and place them in a clean receptacle.

f. When an injector has been in use for some time, the spray tip, even though clean on the outside, may not be pushed readily from the nut with the fingers. In this event, support the nut on a wood block and drive the tip down through the nut (fig. 3–97).

g. Refer to figure 3–107 and remove the spill defector and seal ring from the injector nut.

h. Remove the plunger bushing, gear retainer, and gear from the injector body.

i. Withdraw the injector control rack from the injector body.

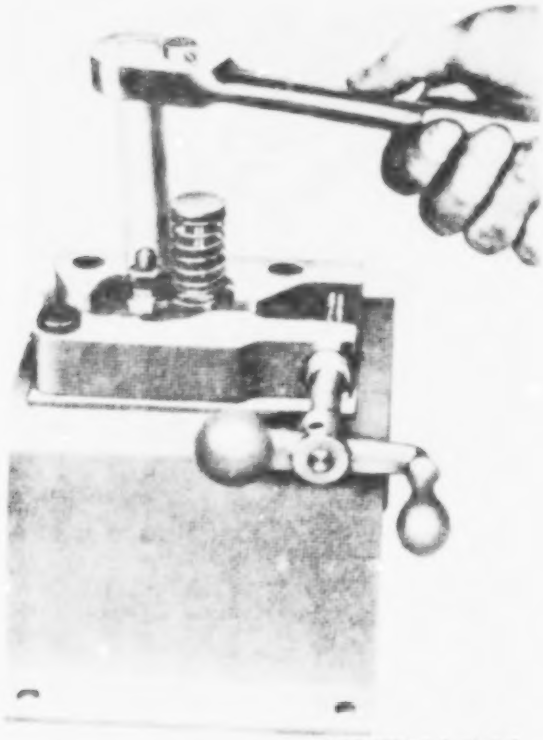


Figure 3–94. Removing or installing filter cap.

3–178. Cleaning

a. General.

(1) Perform all injector repairs in a clean, well lighted room with a dust free atmosphere. An ideal injector room is slightly pressurized by means of an electric fan which draws air into the room through a filter. This pressure prevents particles of dirt and dust from entering the room through the door and windows. A suitable air outlet will remove solvent fumes along with the outgoing air. Also, provide a source for 110 volt AC electric power.

(2) Provide the injector repair room with a supply of filtered, moisture-proof compressed air for drying the injector parts after they have been cleaned.

(3) Use wash pans of rust-proof material and deep enough to permit all of the injector parts to be completely covered by the cleaning agent, usually clean fuel oil, when submerged in wire baskets of 16 mesh wire screen. Use baskets which will support the parts so as to avoid contact with the dirt which settles at the bottom of the pans.

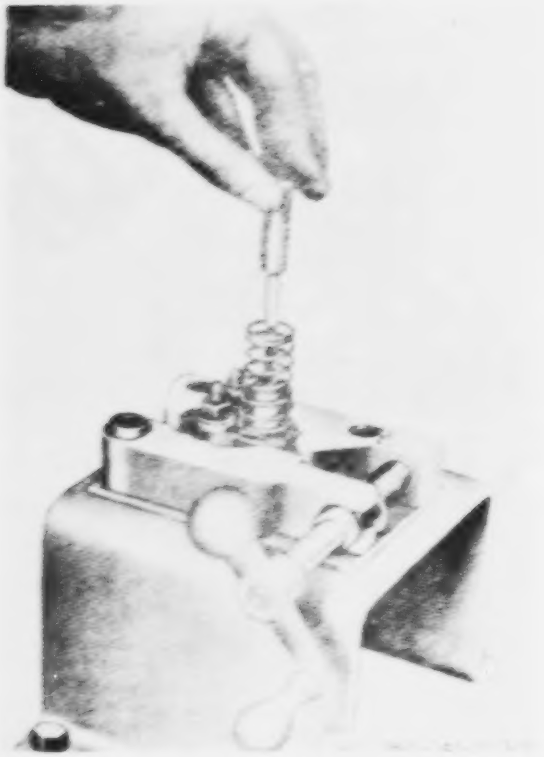


Figure 3-95. Removing or installing injector follower, spring and plunger.

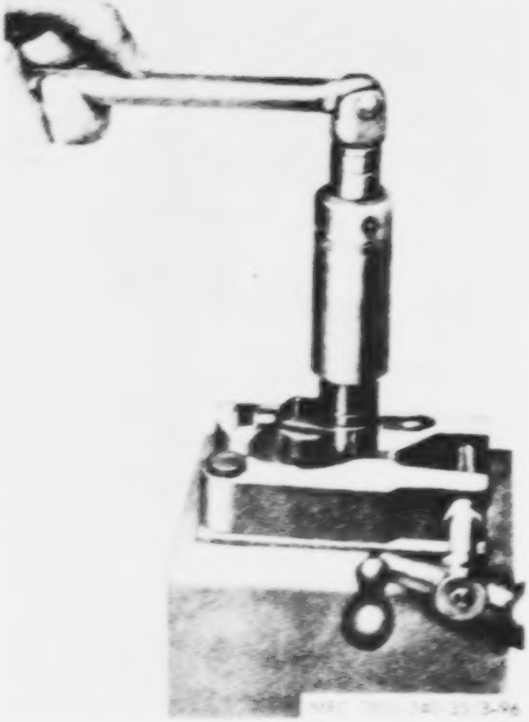


Figure 3-96. Removing injector nut.

Caution: **NEVER use waste or rags for cleaning the injector parts since lint or other particles will clog parts of the injector when it is assembled. A lint free cleaning tissue is a good, inexpensive material for wiping injector parts.**

(4) Wash all of the parts with clean fuel oil or a suitable cleaning solvent and dry them with clean, filtered compressed air. Clean out all passages, drilled holes, and slots in all of the injector parts.

(5) Since most injector difficulties are the result of dirt particles, it is essential that a clean area be provided on which to place the injector parts after cleaning and inspection.

(6) After washing, submerge the parts in a clean receptacle containing clean fuel oil. Keep the parts of each injector assembly together.

b. Spray Tip.

(1) Carbon on the inside of the spray tip may be loosened for easy removal by soaking for approximately 15 minutes in a suitable solution prior to the external cleaning and buffing operation. Methyl ethyl ketone solution is recommended for this purpose.

(2) Clean the spray tip with a reamer (fig. 3-98). Turn the reamer in a clockwise direction to remove the carbon deposits. Wash the spray tip and dry it with compressed air.

(3) Clean the spray tip orifices with a pin vise using the proper size spray tip cleaning wire. Use wire to clean .006 inches diameter holes (fig. 3-99).

(4) However, before using the wire, hone the end until it is smooth and free of burrs using a fine stone. Allow the wire to extend 1/8 inch from tool. The exterior surface of an injector spray tip may be cleaned by using a brass wire buffing wheel. To obtain a good polishing effect and longer brush life, install the buffing wheel in a motor that turns the wheel at approximately 3000 rpm. For a convenient method of holding the spray tip while cleaning and polishing, place the tip over the drill end of the spray tip cleaner and hold the body of the tip against the buffing wheel. In this way the spray tip is rotated while being buffed.

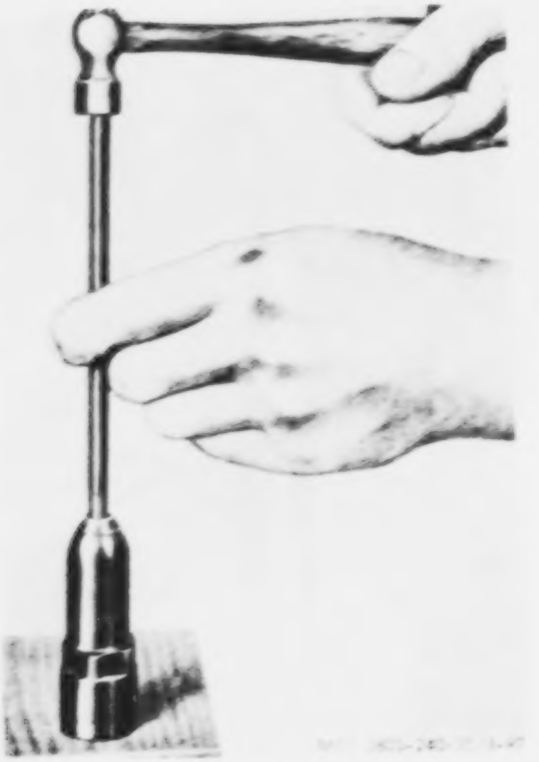


Figure 3-97. Removing spray tip from injector nut.

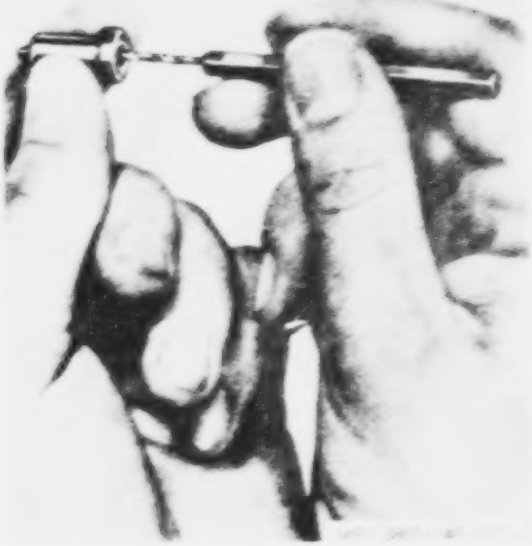


Figure 3-98. Cleaning injector spray tip.

(5) When the body of the spray tip is clean, lightly buff the tip end in the same manner. This cleans the spray tip orifice area and will not plug the orifices.

(6) Wash the spray tip in clean fuel oil and dry it with compressed air after cleaning the orifices.

c. Nut.

(1) Carefully insert the reamer in the injector nut as shown in figure 3-100. Turn the reamer in a clockwise direction to remove the carbon deposits. Use care in reaming to prevent the removal of metal or setting up burrs on the spray tip seat.

(2) The purpose of the tool is to remove carbon build-up only, and is NOT meant to refinish the end area of the nut by removing metal.

(3) Wash the injector nut in clean fuel oil and dry it with compressed air.

(4) Carbon deposits on the spray tip seating surface of the injector nut will result in poor sealing and consequent fuel leakage around the spray tip.

d. Body.

(1) Clean and brush all of the passages in the injector body, using a fuel hole cleaning brush and rack hole cleaning brush. Blow out the passages and dry them with compressed air.

(2) Carefully insert the reamer in the injector body (fig. 3-101). Turn it in a clockwise direction a few turns; then remove the reamer and check the face of the ring for reamer contact. If the reamer does not make contact over the entire face of the ring, repeat the reaming procedure. Clean up the opposite side of the ring in the same manner.

e. Plunger.

(1) When handling the injector plunger, do not touch the finished plunger surfaces with your fingers.

(2) Wash the plunger and bushing with clean fuel oil and dry them with compressed air.

(3) Be sure the high pressure bleed hole in the side of the bushing is not plugged. If this hole is plugged fuel leakage will occur at the upper end of the bushing where it will drain out of the injector body vent and rack holes, during engine operation, causing a serious oil dilution problem.

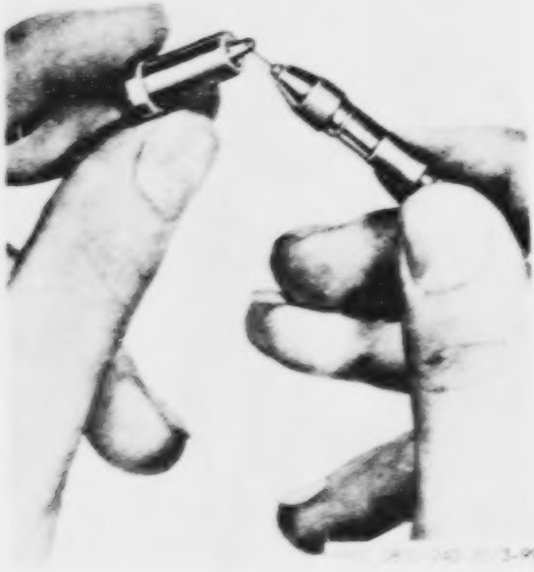


Figure 3-99. Cleaning spray tip orifices.

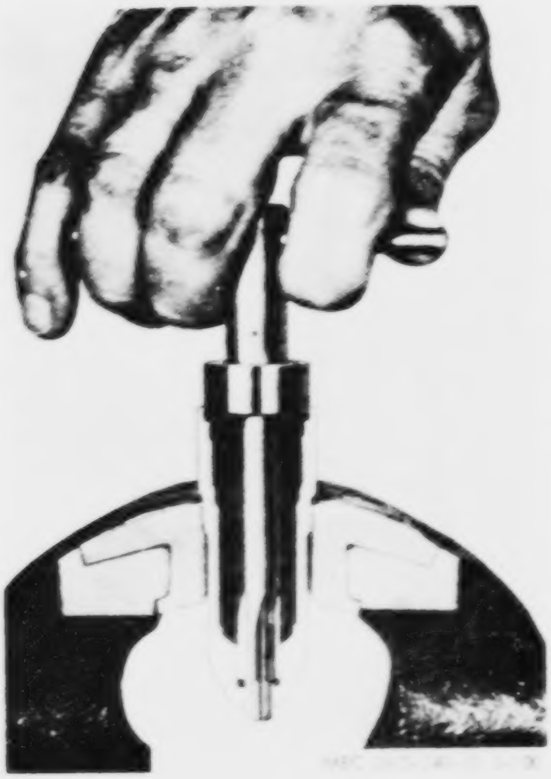


Figure 3-100. Cleaning injector nut spray tip seat.

(4) Keep the plunger and bushing together as they are mated parts.

3-179. Inspection and Repair

a. Inspect the teeth on the control rack and the control rack gear for excessive wear or damage. Also, check for wear in the bore of the gear and inspect the gear retainer. Replace the injector if parts are damaged or worn.

b. Inspect the injector follower for wear.

c. Inspect both ends of the spill deflector for sharp edges or burrs which could create burrs on the injector body or injector nut and cause particles of metal to be introduced into the spray tip and valve parts. Burrs may be removed with a 500 grit stone.

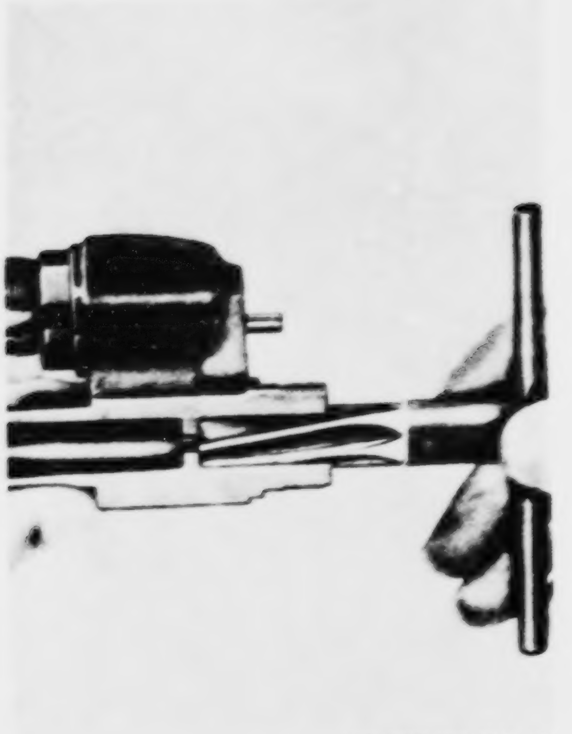
d. Inspect the follower spring for defects and check the spring with a spring tester and an accurate torque wrench. The injector follower spring (.142" diameter wire), has a free length of approximately 1.504" and should be replaced when a load of less than 70 lbs. will compress it to 1.028".

e. Check the seal ring area on the injector body for burrs or scratches. Also, check the surface which contacts the injector bushing for scratches, scuff marks, or other damage. If necessary, lap this surface. A faulty sealing surface at this point will result in a high fuel consumption and contamination of the lubricating oil. Replace any loose injector body plugs or a loose dowel pin. Install the proper number tag on a service replacement injector body.

f. Inspect the injector plunger for scoring, erosion, chipping, or wear. Check for sharp edges on that portion of the plunger which rides in the gear. Remove any sharp edges with a 500 grit stone. Wash the plunger after stoning it. Check the plunger bushing for cracks or chipping. Slip the plunger into the bushing and check for free movement. If these parts are worn, chipped or scored, replace the injector assembly.

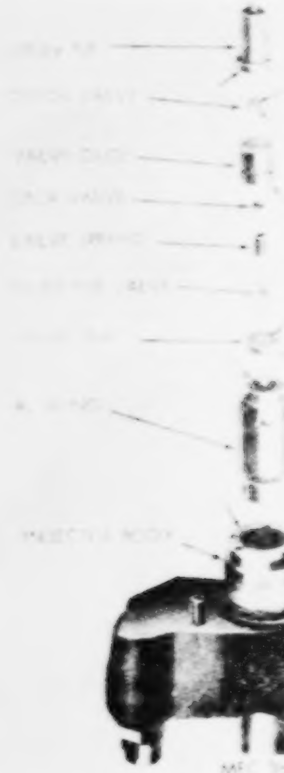
g. Examiene the spray tip seating surface of the injector nut for nicks, burrs, or brinelling. Reseat the surface or replace the injector if it is severely damaged.

h. The injector valve spring plays an important part in establishing the valve opening pressure of the injector assembly. Replace a worn or broken spring.



MEC 3805-240-35/3-101

Figure 3-101. Cleaning injector body ring.



MEC 3805-240-35/3-102

Figure 3-102. Sealing surfaces which may require

i. Inspect the sealing surfaces of the spray tip and valve parts indicated in figure 3-102. Examine the sealing surfaces with a magnifying glass, as shown in figure 3-103, for even the slightest imperfections will prevent the injector from operating properly. Check for burrs, nicks, erosion, cracks, chipping and excessive wear. Also, check for enlarged orifices in the spray tip. Replace damaged or excessively worn parts.

j. Before reinstalling used valve parts in an injector, lap all of the sealing surfaces indicated in figure 3-102 (excep the crown valve). It is also good practice to lightly lap new valve parts (except the crown valve) which may become burred or nicked during handling. Lap the sealing surfaces indicated in figure 3-102 as follows:

(1) Clean the lapping blocks with compressed air. Do not use a cloth or any other material for this purpose.

(2) Spread a good quality 600 grit dry lapping powder on one of the lapping blocks.

(3) Place the part to be lapped flat on the blocks as shown in figure 3-104 and, using a figure eight motion, move it back and forth across the block. Do not press on the part, but use just enough pressure to keep the part flat on the block. It is important that the part be kept flat on the block at all times.

(4) After each four or five passes, clean the lapping powder from the part by drawing it across a clean piece of tissue placed on a flat surface and inspect the part. Do not lap excessively.

(5) When the part is flat, wash it in cleaning solvent and dry it with compressed air.

(6) Place the dry part on the second block. After applying lapping powder, move the part lightly across the block, in a figure eight motion, several times to give it a smooth finish. Do not lap excessively. Again, wash the part in cleaning solvent and dry it with compressed air.

(7) Place the dry part on the third block Do not use lapping powder on this block. Keep the part flat and move it across the block several times, using the figure eight motion. Lapping the dry part in this manner gives it the "mirror" finish required for perfect sealing.

(8) Examine the edge of the hole in the crown valve seat under a magnifying glass. If the edge of the hole shows small irregularities, lap the hole with a lapping tool. Since only the edge of this hole contacts the valve, it must be a

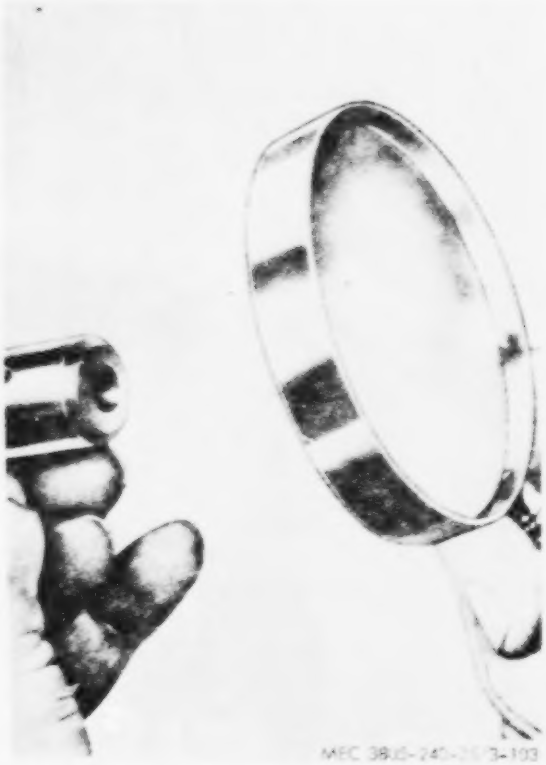


Figure 3-103. Examining sealing surface with a magnifying glass.

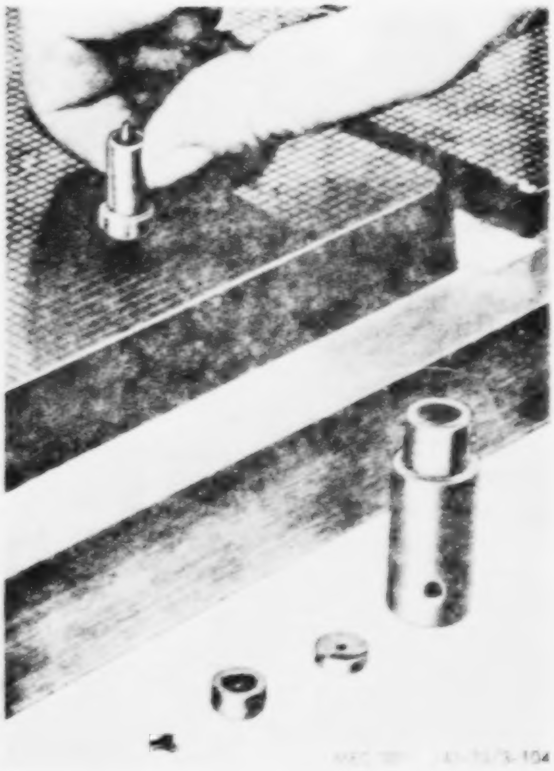


Figure 3-104. Lapping spray tip on lapping blocks.

true circle and present an unbroken surface. Mount tool in a drill motor (fig. 3-105) and place a small amount of lapping powder and oil mixture on the tool. Place the valve seat over the pilot of the tool and start the drill motor. Touch the valve seat lightly against the rotating lapping tool to produce a uniform seat at the hole. After lapping the edge of the hole in this manners, flat lap the face of the seat lightly. Then, clean and examine the width of the chamfer produced at the edge of the hole. The specified width is .002" to .005". A width in excess of these limits, due to excessive lapping, will lower the valve opening pressure of the injector.

(9) Wash all of the lapped parts in clean fuel oil and dry them with compressed air.

3-180. Reassembly

a. General.

(1) Use an extremely clean bench to work on when assembling an injector.

(2) Study figures 3-106, 3-107 and 3-108 for the proper relative positions of the injector parts, then proceed as follows:

b. Injector Filters.

(1) Hold the injector body right side up, place a new filter, dimple end down, in each of the fuel cavities in the top of the injector body (fig. 3-106).

(2) Place a spring on top of each filter and a new gasket on each filter cap. Lubricate the threads and install the filter caps. Use a 9/16" deep socket wrench as shown in figure 3-94 to tighten the filter caps to 65-75 lb-ft torque.

(3) Install clean shipping caps on the filter caps to prevent dirt from entering the injector.

Caution: **Make sure that new filters have been installed in a reconditioned injector which is to be placed in stock. This precaution will prevent dirt particles from entering the injector due to a possible reversal or fuel flow when installing the injector in an engine other than the original unit.**

c. Rack and Gear.

(1) Hold the injector body bottom end up and slide the rack through the hole in the body. Look into the bore for the gear, then move the rack so that the drill marks (fig. 3-107) can be observed and hold the rack in this position.

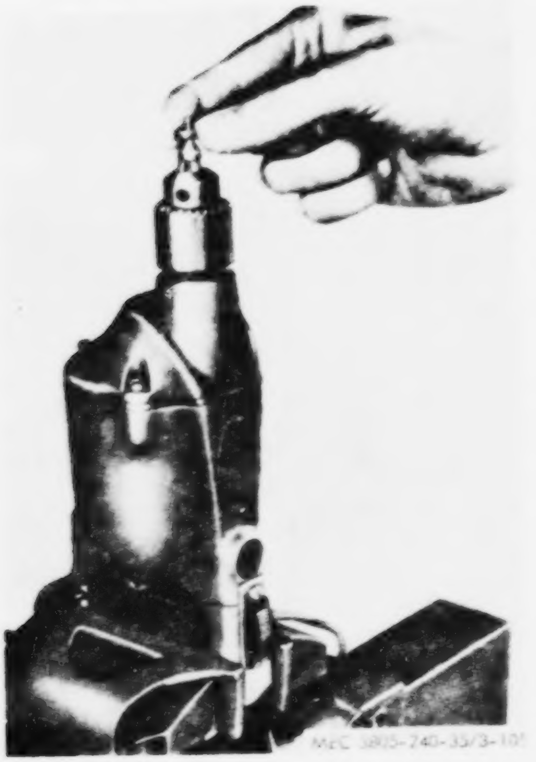


Figure 3-105. Lapping edge of hole in valve seat.

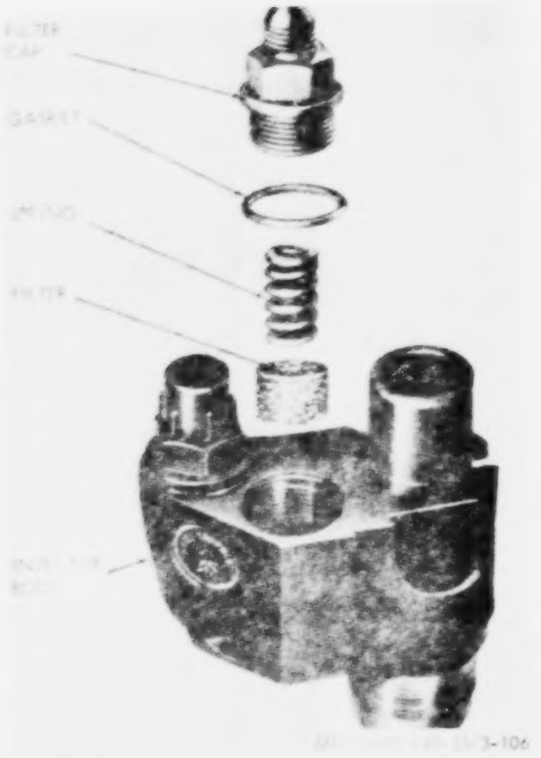


Figure 3-106. Details of injector filters, springs, and caps showing their location relative to injector body.

(2) Slide the gear into the injector body so that the marked tooth is engaged between the two marked teeth on the rack.

(3) Place the gear retainer on top of the gear. Next aline the locating pin in the bushing with the slot in the injector body and slide the end of the bushing into place.

d. Injector Valve and Related Parts.

(1) Support the injector body, bottom end up, in the assembly fixture, or in injector vise jaws.

(2) Place a new seal ring on the shoulder of the injector body. Slide the spill deflector over the barrel of the bushing.

(3) Place the valve seat on the end of the bushing. Insert the stem of the valve in one end of the valve spring and the valve stop in the other end. Lower the valve cage over this assembly so that the valve stop seats in the cage. Place the valve cage assembly on the valve seat.

(4) Locate the check valve centrally on the cage and place the spray tip over the check valve and against the valve cage.

(5) Lubricate the threads in the injector nut and carefully thread the nut on the injector body by hand. Rotate the spray tip between your thumb and first finger while threading the nut on the injector body (fig. 3-109). As the nut is being tightened by hand, the spray tip should be increasingly difficult to turn. When the nut is turned down as far as possible by hand, the spray tip should then be too tight to turn with your fingers.

e. Plunger and Follower.

(1) Refer to figure 3-95 and slide the head of the plunger into the follower. Insert this assembly through the follower spring.

(2) Invert the injector in the assembly fixture (filter cap end up) and push the rack all the way IN. Then, insert the free end of the plunger in the injector body.

(3) Refer to figures 3-110 and 3-111 and place the stop pin on the injector body so that the tighter wound end of the follower spring rests on the narrow flange of the stop pin. This end has been cut so that the end point is to the outside. Then, aline the slot in the follower with the stop pin hole in the injector body. Next, aline the flat side of the plunger with the flat in

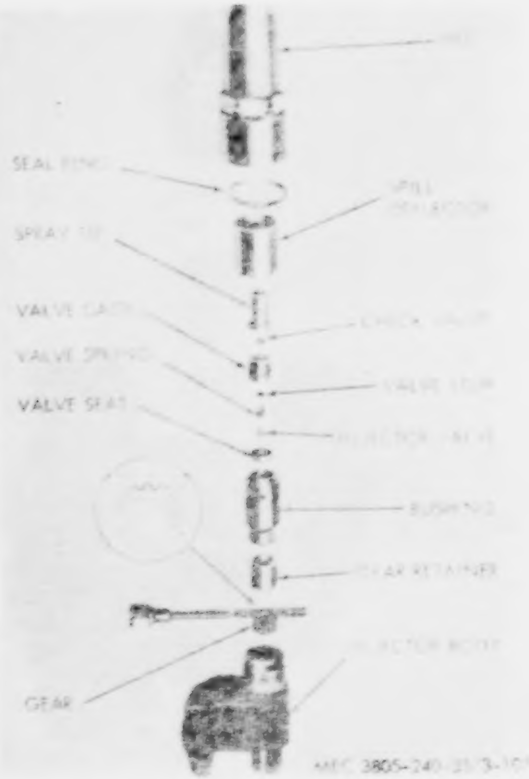

SEAL RING
SPILL DEFLECTOR
SPRAY TIP
VALVE CAGE
CHECK VALVE
VALVE SPRING
VALVE STOP
VALVE SEAT
INJECTOR VALVE
BUSHING
GEAR RETAINER
INJECTOR BODY
GEAR
MEC 3805-240-35/3-107

Figure 3–107. Injector rack, gear, spring tip, and valve assembly details and relative location of parts.

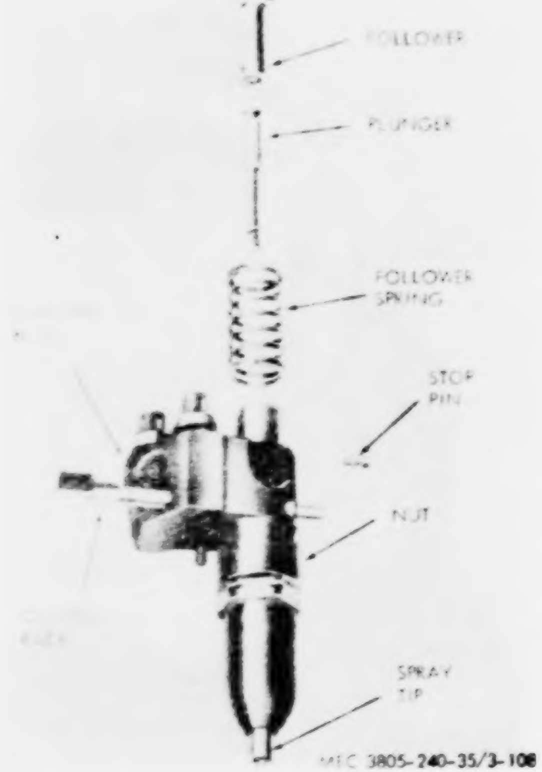

FOLLOWER
PLUNGER
FOLLOWER SPRING
STOP PIN
NUT
SPRAY TIP
MEC 3805-240-35/3-108

Figure 3–108. Injector plunger, follower and relative location of parts.

the gear. Press down on the follower and at the same time press the stop pin into position. When in place, the spring will hold the stop in position.

(4) Invert the injector assembly in the fixture. Use socket and a torque wrench to tighten the injector nut to 55–65 lb-ft torque (fig. 3–112).

Caution: **Do not exceed the specified torque. Otherwise, the nut may be stretched and result in improper sealing of the lapped surfaces in a subsequent injector overhaul.**

3–181. Testing

a. To assure correct alinement, check the concentricity of the spray tip as follows:

(1) Place the injector in the concentricity gage as shown in figure 3–113 and adjust the dial indicator to zero.

(2) Rotate the injector 360° and note the total runout as indicated on the dial.

(3) If the total run-out exceeds .008", remove the injector from the gage. Loosen the injector nut, center the spray tip, and tighten the nut to 55–65 lb-ft torque. Recheck the spray tip concentricity. If, after several attempts, the spray tip cannot be positioned satisfactorily, check the assembly of the entire injector.

b. Before placing a reconditioned injector in service, perform all of the tests (except the visual inspection of the plunger) previously outlined in paragraph 3–176.

3–182. Installation

a. When a reconditioned injector is to be placed in stock, fill it with a good grade of rust preventive oil. Injector test oil is suitable for this purpose. Do not use fuel oil. Install shipping caps on the filter caps immediately after filling.

b. The injector is satisfactory if it passes these tests. Failure to pass any one of the tests indicates that defective or dirty parts have been assembled. In this case, disassemble, clean, inspect, assemble, and test the injector again.

c. Before installing an injector in an engine, remove the carbon deposits from the beveled seat of the injector tube in the cylinder head. This will assure correct alinement of the injector and

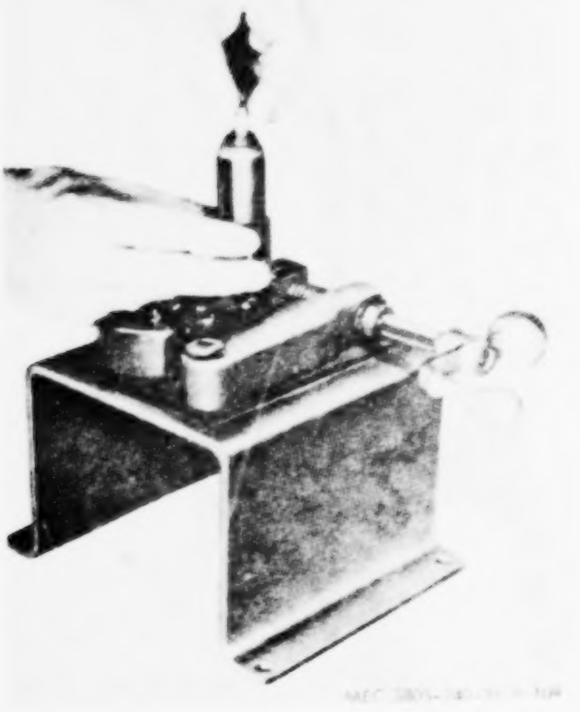


Figure 3-109. Tightening injector nut by hand.

prevent any undue stresses from being exerted against the spray tip.

(1) Use the injector tube bevel reamer to clean carbon from the injector tube.

(2) Exercise care to remove ONLY the carbon so that the proper clearance between the injector body and the cylinder head is maintained.

(3) Pack the flutes of the reamer with grease to retain the carbon removed from the tube.

d. Be sure the fuel injector is filled with fuel oil. If necessary, add clean fuel oil at the inlet filter cap until it runs out the outlet filter cap.

e. Install the injector in the engine as follows:

(1) Refer to figure 3-83 and insert the injector into the injector tube with the dowel registering with the locating hole in the cylinder head.

(2) Slide the rack control lever over so that it registers with the injector rack.

(3) Place the injector clamp in place and install the special washer. Install the bolt and tighten it to 20-25 lb-ft torque. Make sure that the clamp does not interfere with the exhaust valve or injector springs.

Note. Check the injector control rack for free movement. Excess torque can cause the control rack to stick or bind.

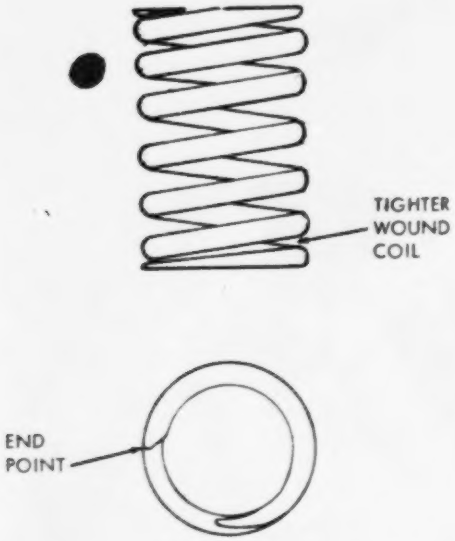
Figure 3-110. Installing injector follower stop pin.

(4) Move the rocker arm assembly into position and secure the rocker arm brackets to the cylinder head, by tightening the bolts to the torque specified in paragraph 1-4.

(5) Remove the shipping caps. Then, install the fuel pipes and connect them to the injectors and the fuel connectors. Use a socket to tighten the connections to 12-15 lb-ft torque.

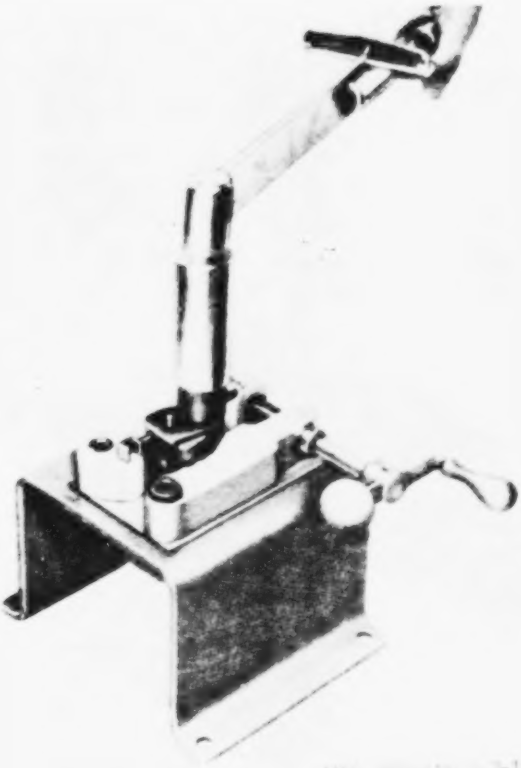
***Caution:* Do not bend the fuel pipes and do not exceed the specified torque. Excessive tightening will twist or fracture the flared end of the fuel line and result in leaks. Lubricating oil diluted by fuel oil can cause serious damage to the engine bearings.**

(6) After installing the injectors in the engine, perform a complete engine tune-up as outlined in paragraph 3-202. However, if only one injector has been removed and replaced and the other injectors and the governor adjustment have not been disturbed, it will only be necessary to adjust the valve clearance and time the injector for the one cylinder, and to position the injector rack control levers.


TIGHTER
WOUND
COIL
END
POINT

MEC 3805-240-35/3-111

Figure 3-111. Follower spring identification.



MEC 3805-240-35/3-112

Figure 3-112. Tightening injector nut with torque wrench.

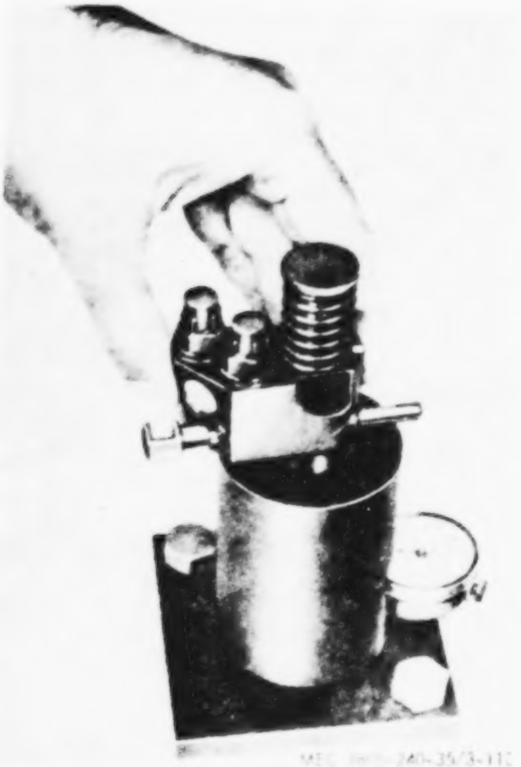


Figure 3-113. Checking injector spray tip concentricity.

Section XXVIII. CYLINDER BLOCK END PLATES

3-183. General

Flat end plates are bolted to each end of the cylinder block. At the time of a complete engine overhaul or of a cylinder block change, the end plates will be removed and reinstalled on the block.

3-184. Removal

a. Remove front end plate assembly (6, fig. 3-114), gasket (7) and gasket (8). Discard the gaskets.

b. Remove rear end plate assembly (13) and gasket (14). Remove cover (17) and gasket (18) from end plate (13).

c. Remove retainers (19 and 20) and breather pads (21 and 22) from cylinder block (48).

3-185. Cleaning

a. Scrape all gasket material from the front and rear end plate assemblies.

b. Clean the end plates in a hot bath of commercial heavy-duty alkaline solution.

c. Wash the clean end plates in hot water or steam clean to remove all traces of alkaline solution.

d. Clean breather pads in cleaning solvent, Specification P-S-661, or equivalent.

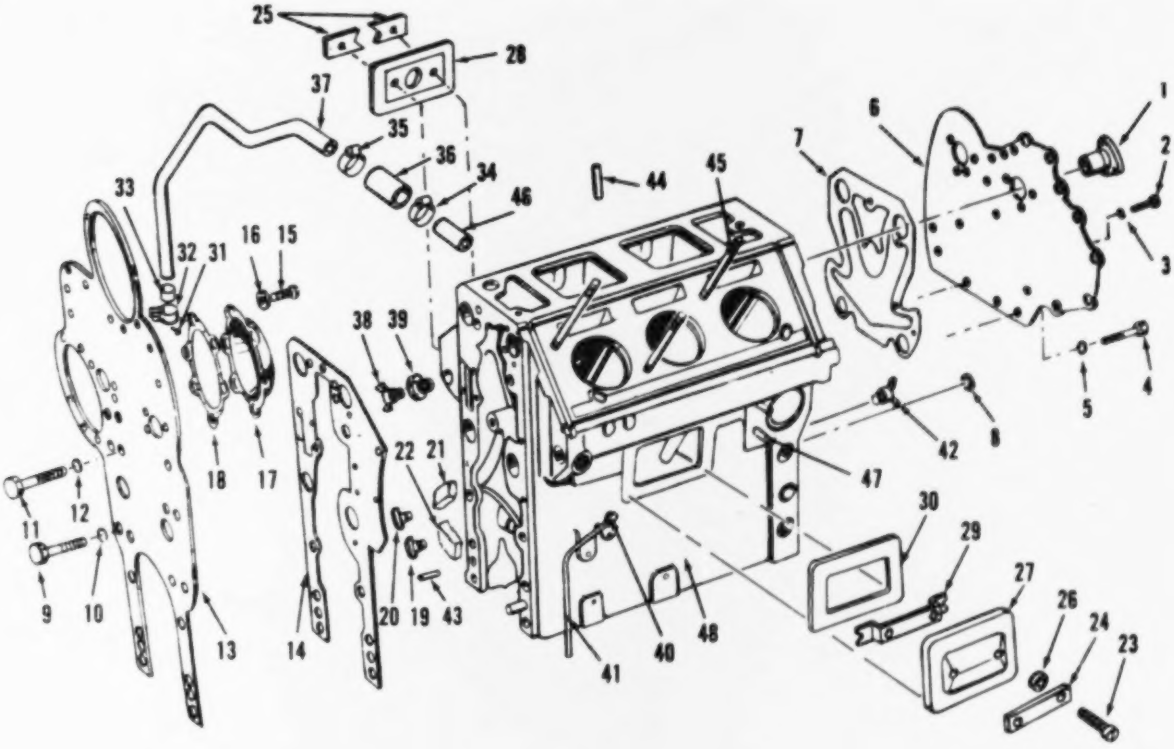
3-186. Inspection and Repair

a. Check the surfaces of the end plate for nicks, dents, scratches or score marks on the gasket surfaces, also check the end plate for flatness.

b. Plug nuts in the end plate should also be checked for cracks and damaged threads.

c. If nicks or scratches on the sealing surfaces of the end plate are too deep to be cleaned up, or the plug nuts are damaged, the end plate or plug nuts must be replaced.

d. When installing a plug nut, support the end plate on a solid flat surface to avoid distorting the plate. Then press the nut in the end plate until the head on the nut seats on the end plate.



MEC3805-240-35/3-114

1 Camshaft end bearing
2 Bolt, 1/2-13 x 1 in. (2 rqr)
3 Lockwasher, 1/2 in. (2 rqr)
4 Bolt, 3/8-16 x 1 in. (3 rqr)
5 Lockwasher, 3/8 in. (3 rqr)
6 Plate assembly, front
7 Gasket, front plate
8 Gasket
9 Bolt, 3/8-16 x 1 in. (3 rqr)
10 Lockwasher, 3/8 in. (3 rqr)
11 Bolt, 3/8-24 x 5/8 in. (2 rqr)
12 Washer, copper, 3/8 in. (2 rqr)
13 Plate assembly, rear
14 Gasket, rear plate
15 Bolt, 3/8-16 x 1 in. (6 rqr)
16 Lockwasher, 3/8 in. (6 rqr)
17 Cover
18 Gasket
19 Retainer, short
20 Retainer, long
21 Breather pad
22 Breather pad
23 Bolt (4 rqr)
24 Lock plate
25 Lock plate (2 rqr)
26 Gasket (4 rqr)
27 Cover, hand hole, R.H.
28 Cover, hand hole L.H.
29 Clamp (2 rqr)
30 Gasket (2 rqr)
31 Screw
32 Clamp
33 Hose
34 Clamp
35 Clamp
36 Hose
37 Pipe, breather
38 Cock, drain
39 Bushing, pipe
40 Connector (2 rqr)
41 Tube (2 rqr)
42 Cock, drain
43 Dowel (2 rqr)
44 Dowel (2 rqr)
45 Stud, cylinder head (6 rqr)
46 Pipe, breather
47 Stud (2 rqr)
48 Block assembly

Figure 3-114. Engine cylinder block assembly, exploded view.

3-187. Installation

a. Install breather pads (21 and 22, fig. 3-114) in the recesses of the cylinder block. Secure the left hand pad with long retainer (20). Secure the right hand pad with short retainer (19). (Left and right are used when facing the rear of the cylinder block.) The rear end plate, when assembled to the cylinder block will apply pressure on retainers (19 and 20) to hold the breather pads (21 and 22) in position.

b. Affix new gaskets (7 and 14) to the ends of the cylinder block (48), using a non-hardening gasket cement. Also apply an even coating of cement to the outer surface of each gasket surface.

c. Attach the front end plate (6) to the cylinder block (48) with bolts (4) and lockwashers (5). Tighten the bolts finger tight, only.

d. Wipe the excess gasket cement from the bores in the end plate and cylinder block.

e. Insert the right bank camshaft and bearing (1) through the small bearing bore in the end plate (6) and into the bore of the block to accurately aline the end plate with the cylinder block.

Note. The holes in the front and rear end plates for the camshaft end bearings are not the same size. The smaller hole is accurately machined for alinement purposes and is always located on the right side of the engine as viewed from the rear.

f. With the bearing (1) in place, tighten the 1/2-13 NC end plate-to-cylinder block bolts to 71-75 foot-pounds torque. Tighten the 3/8-16 bolts to 30-35 foot-pounds torque. Then, remove the camshaft bearing (1) which served as a pilot while attaching the front end plate.

g. Install gasket (18) and cover (17) on rear end plate (13); secure cover with lockwashers (16) and bolts (15).

h. Attach the rear end plate (13) to the cylinder block (48) with bolts (9) and lockwashers (10). Tighten the bolts finger tight only.

i. Wipe the excess gasket cement from the bores in the end plate and cylinder block.

j. Insert the right bank camshaft end bearing (1) through the small bearing bore in the end plate (13) and into the bore of the block to accurately align the end plate with the cylinder block. (Right hand bore when viewed from the rear.)

k. With the bearing (1) in place, tighten the bolts (9) to 30-35 foot-pounds torque. Then remove the camshaft bearing (1).

Section XXIX. CYLINDER BLOCK AND OIL COOLER ASSEMBLY

3-188. General

The engine cylinder block is the main structural part of the engine. Therefore, various subassemblies and parts must be removed from the block whenever the engine is being reconditioned.

3-189. Disassembly

Disassemble the cylinder block and oil cooler assembly in the numerical sequence as illustrated in figures 3-114 and 3-115.

3-190. Cleaning

a. Remove all of the plugs and scrape all gasket material from the cylinder block. Also, remove all of the core hole plugs to allow the cleaning solution to contact the inside of the water and oil passages. This will permit more efficient cleaning and eliminate the possibility of the cleaning solution attacking the aluminum water hole plug gaskets, which would result in internal leaks and eventual engine damage.

b. After a cylinder block has been in service, water hole plugs may be difficult to remove. To facilitate removal, hold a 3/4 inch drift against the plug and give it a few sharp blows at the top, both sides, and bottom with a one pound hammer. Exercise care when striking the drift so as not to damage the cylinder block. After the plugs have been loosened, they will be easily removed with a 1/2 inch flexible handle and a short extension placed in the countersunk hole in the face of the plug.

c. Then, with the plugs removed clean the cylinder block and oil cooler core as follows:

(1) Remove the grease by agitating the cylinder block and core in a hot bath of commercial heavy-duty alkaline solution.

(2) Wash in hot water or steam clean to remove alkaline solution.

(3) If the water jackets are heavily scaled, proceed as follows:

(*a*) Agitate the block in a bath of inhibited commercial pickling acid. Allow the block to remain in the acid bath until the bubbling action stops (approximately 30 minutes).

(*b*) Lift the block, allow it to drain and reimmerse it in the same acid solution for 10 minutes. Repeat operation until all of the scale is removed.

(*c*) Rinse the block in clear, hot water to remove the acid solution.

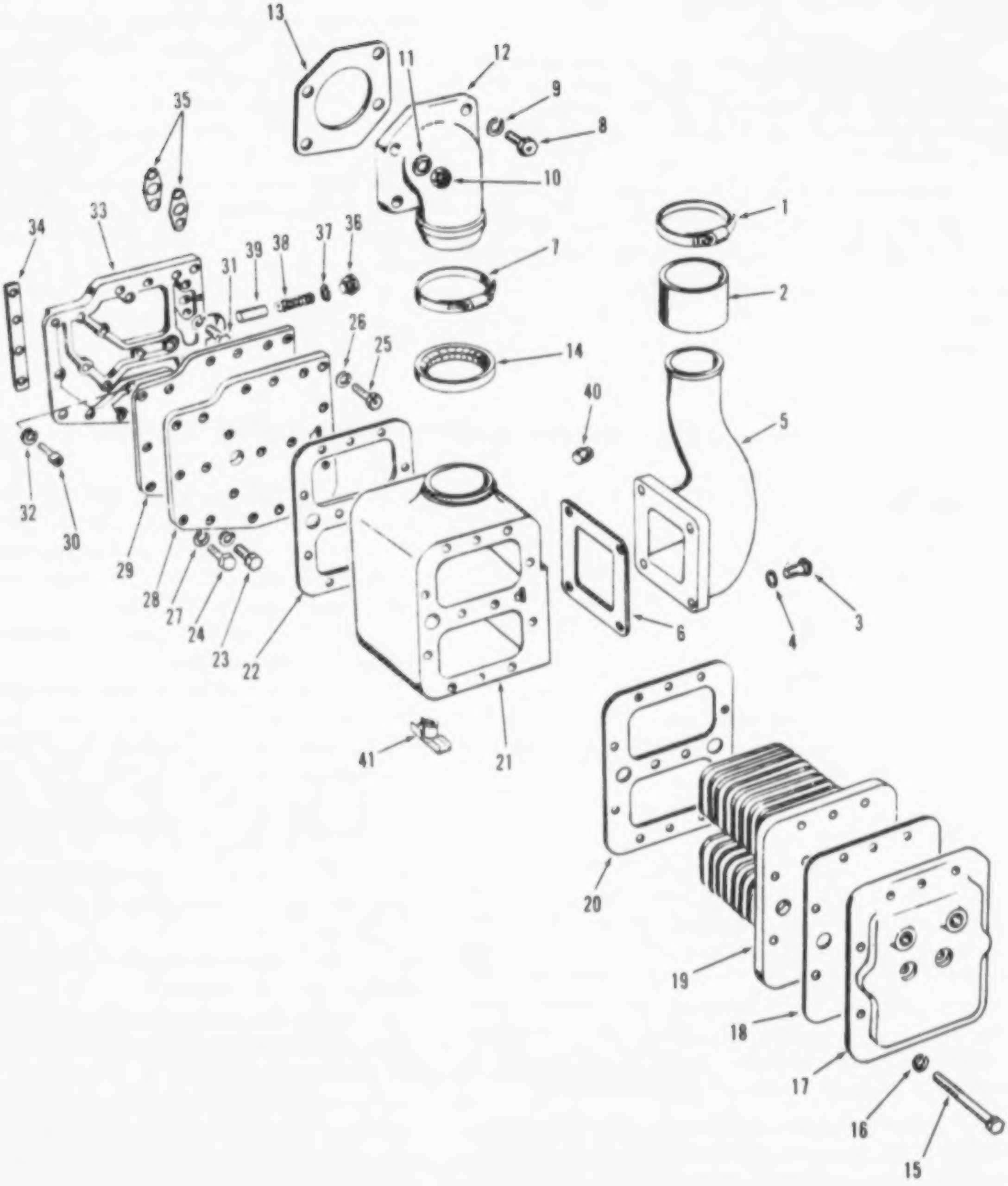
(*d*) Neutralize any remaining acid that may cling to the casting by immersing the block in an alkaline bath.

(*e*) Wash the block in a bath of clean water or steam clean it.

(4) Dry the cylinder block with compressed air.

(5) Make certain that all of the water passages, oil galleries and air box drain openings have been thoroughly cleaned to permit the cooling and lubricating systems to function efficiently.

(6) After the cylinder block has been thoroughly cleaned and dried, coat the threads of the plugs with sealant and, using new gaskets,


13
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MEC3805-240-35/3-115

Figure 3-115. Oil cooler, exploded view.

1 Clamp
2 Hose (to water pump)
3 Bolt, 3/8-16 x 1 1/8 in. (4 rqr)
4 Lockwasher, 3/8 in. (4 rqr)
5 Elbow
6 Gasket
7 Clamp
8 Bolt 3/8-16 x 1 in. (2 rqr)
9 Lockwasher, 3/8 in. (2 rqr)
10 Nut, 3/8-24 Hex (2 rqr)
11 Washer, Copper, 3/8 in. (2 rqr)
12 Elbow
13 Gasket
14 Seal ring
15 Bolt, 5/16-18 x 5 in. (12 rqr)
16 Lockwasher, 5/16 in. (12 rqr)
17 Cover (rear)
18 Gasket
19 Core
20 Gasket
21 Housing
22 Gasket
23 Bolt, 3/8-16 x 1 1/4 in.
24 Bolt, 3/8-16 x 2 in.
25 Bolt, 5/16-18 x 7/8 in.
26 Lockwasher, 5/16 in.
27 Lockwasher, 3/8 in.
28 Cover Plate
29 Gasket
30 Bolt, 3/8-16 x 1 1/4 in. (4 rqr)
31 Bolt, 3/8-16 x 1 in. (2 rqr)
32 Lockwasher, 3/8 in.
33 Adapter
34 Gasket (spacer)
35 Gasket (2 rqr)
36 Plug
37 Gasket
38 Spring
39 Valve
40 Plug, pipe
41 Drain cock

Figure 3-115—Continued

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reinstall the core hole plugs. Tighten the plugs to 75-100 foot-pounds torque.

3-191. Inspection and Repair

a. Pressure Test.

(1) Seal off the water inlet and outlet holes air tight. This can be done by using plates and suitable rubber gaskets held in place by bolts.

(2) Immerse the cylinder block and oil cooler core for twenty minutes in a tank of water heated to 180°—200° F.

(3) Use a suitable fitting at one of the water inlet or outlet openings and apply 80-100 PSI air pressure to the water jacket. Observe the water in the tank for bubbles indicating cracks or leaks.

(4) After the pressure test is completed blow out the passages with dry compressed air.

(5) Replace the cylinder block or oil cooler core if leaks or cracks are detected in the water or oil passages.

b. Bore Honing.

(1) Use a hone in which the cutting radius of the stones can be set in a fixed position to remove irregularities in the bore rather than following the irregularities as with a spring loaded hone. Clean the stones frequently with a wire brush to prevent stone loading.

(2) Follow the hone manufacturers instructions regarding the use of oil or kerosene on the stones. Do not use such cutting agents with a dry hone. Use 120 grit stones.

(3) Insert the hone in the cylinder bore and adjust the stones snugly to the narrowest section. When correctly adjusted, the hone will not shake in the bore, but will drag freely up and down the bore when the hone is not running.

(4) Start the hone and "feel out" the bore for high spots. These will cause an increased drag on the stone. Move the hone up and down the bore with short overlapping strokes about 1 inch long. Concentrate on the high spots in the first cut. As these are removed, the drag on the hone will become lighter and smoother. Do not hone as long at the air inlet port area as in the rest of the bore because this area, as a rule, cuts away more rapidly. Feed lightly to avoid an excessive increase in the bore diameter. Some stones cut rapidly even under low tension.

(5) When the bore is farily clean, remove the hone, inspect the stones, and measure the bore. Determine which spots must be honed most. Moving the hone from the top to the bottom of the bore will not correct an cut-of-round condition. To remain in one spot too long will cause the bore to become irregular. Where and how much to hone can be judged by feel. A heavy cut in a distorted bore produces a steady drag on the hone and makes it difficult to feel the high spots. Therefore, use a light cut with frequent stone adjustments.

(6) Wash the cylinder block thoroughly after the honing operation is completed.

c. Inspection.

(1) Inspect the cylinder block bores. Whenever the cylinder liners are removed from an engine the bores in the block must be inspected. Since most of the engine cooling is accomplished by heat transfer through the cylinder liners to the water jacket, a good liner-to-block contact must exist when the engine is operating.

Note. Before attempting to check the block bores, hone them throughout their entire length, as described under step *b*, until about 75% of the area above the ports has been "cleaned-up".

(2) Visually check the contact areas revealed by the honed surface. There must not be any low spots which are larger in area than a half dollar.

(3) Measure the entire bore with special cylinder bore gage, which has a dial indicator calibrated in 0.001 inch increments (fig. 3-116).

The standard block bore is 4.6260 to 4.6270 inches. This bore will produce a fit of 0.000 to 0.002 inch. First, plate the bore gage in special master ring gage, and set the dial to zero; then, rotate the dial clockwise 0.0005 inch. Next, take measurements, on the cleaned-up surfaces only, at positions A, B, C, D, E and F in the bore on axes 90° apart (fig. 3-117). Read the measurements from the zero mark on the gage.

(4) Each bore in a used block must not be out-of-round or tapered more than 0.002 inch.

(5) Check the cylinder liner counterbores for proper depth and diameter. The counterbores must be from 5.046 to 5.051 inch in diameter and 0.477 to 0.495 inch in depth. The counterbored surface must not vary in depth more than 0.0015 inch around the entire circumference and no two adjacent counterbores may vary in depth more than 0.001 inch when gaged along the longitudinal cylinder centerline (fig. 3-118).

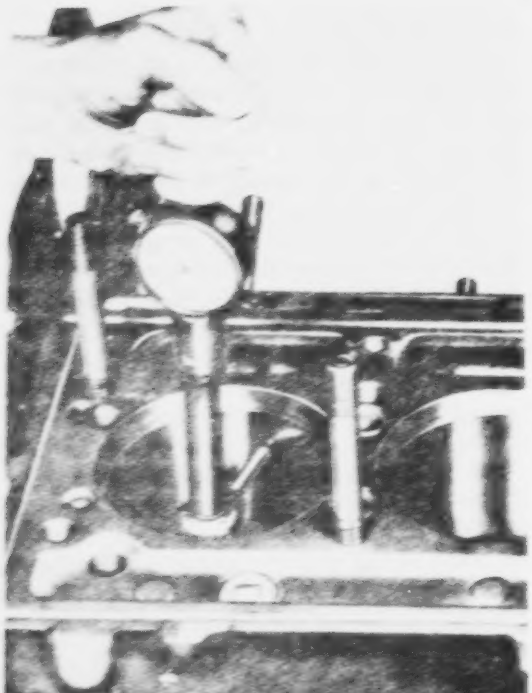


Figure 3-116. Checking cylinder block bore.

(6) Each cylinder bore has been counterbored to accommodate a spacer. This spacer, known as a cylinder liner insert, provides a replaceable seating surface for the cylinder liner flange. In the event of brinelling of the liner flange into the insert, the insert may be replaced and thus provide a new seating surface for the liner.

(7) The bottom surface of the cylinder liner insert must contact the counterbore all the way around, and both the top and bottom surfaces of the insert must be smooth and flat.

(8) Cylinder head studs must be replaced if they have been damaged. Whenever cylinder head studs are replaced, the studs must extend 4 3/8 ± 1/32 inch above the top surface of the block, when torqued to 75 foot-pounds minimum.

(9) Check the main bearing bore diameter with the main bearing caps secured in place and bolts tightened to 180 to 190 foot-pounds torque. Bearing caps are numbered to correspond with their respective positions in the block. The number of the front main bearing cap is also stamped on the face of the oil pan mounting flange of the cylinder block, adjacent to its permanent location in the engine as established at the time of manufacture. The No. 1 cylinder and main bearing cap is always located at the end opposite the flywheel end of the cylinder block, regardless of engine rotation. The standard bore diameter is 4.812 to 4.813 inches and, if they do not fall within these limits the cylinder block must be rejected.

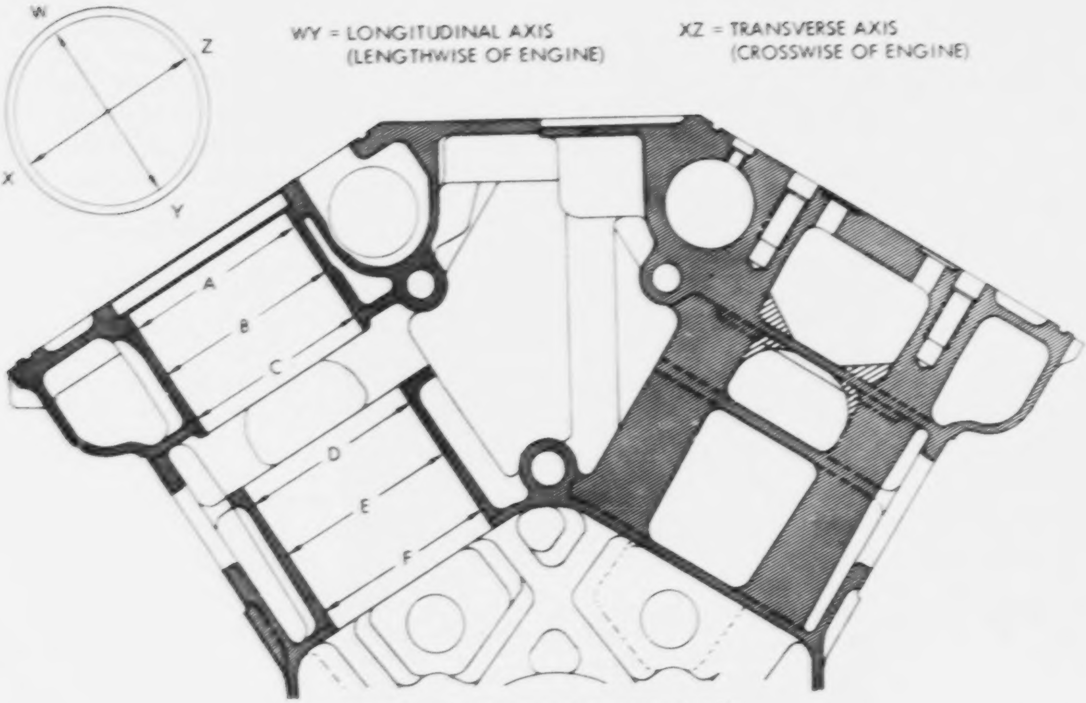
(10) Check the remaining cylinder block surfaces and threaded holes. Check all of the mating surfaces, or mounting pads, for flatness, nicks and burrs. Clean-up damaged threads in the tapped holes with a tap or install helical threaded inserts.

(11) Check the dowels at the ends of the cylinder block. They must extend 0.88 inch from the ends of the block.

(12) After inspection, if the cylinder block is not to be used immediately, spray the machined surfaces with engine oil.

3-192. Reassembly

Reassemble the cylinder block and oil cooler in reverse of the numerical sequence as illustrated on figures 3-114 and 3-115.



WY = LONGITUDINAL AXIS
(LENGTHWISE OF ENGINE)

XZ = TRANSVERSE AXIS
(CROSSWISE OF ENGINE)

MEASURE INSIDE DIAMETER OF BLOCK BORE AT PLACES A, B, C, D, E, AND F ON "WY" AND "XZ" AXIS.

MEC 3805-240-35/3-117

Figure 3-117. Cylinder block bore measuring points.

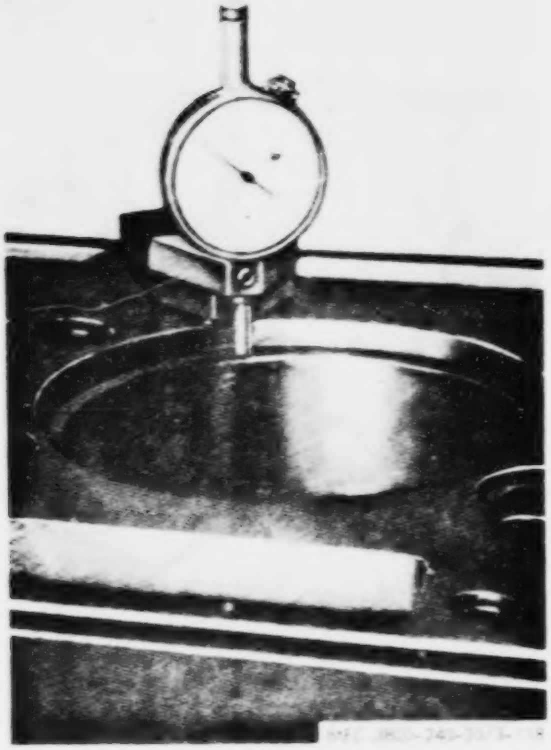

MEC 3805-240-35/3-118

Figure 3–118. Checking depth of counter bore.

Section XXX. OPERATION AFTER ENGINE OVERHAUL

3–193. General

a. Following any major repairs, the ditcher must be operated and performance-tested to ensure that it has been restored to good operating condition.

b. Perform the initial postoverhaul operations with particular care.

c. If any instruments register incorrectly, or if any unusual noises are noticed, refer to the troubleshooting guide, paragraph 2–3 and correct the cause before proceeding.

3–194. Preliminary Inspection

Refer to TM 5–3805–240–12 and perform the preoperation services detailed.

3–195. Starting

a. Refer to TM 5–3805–240–12 and start the engine, observing all the cuations.

b. Pay particular attention to the instruments and shut-down the engine immediately if any instruments register in the red areas of the dials.

3–196. Engine Run-In

a. If any major engine overhaul has been done, run-in the engine before operating the ditcher.

b. Table 1–3 gives engine run-in times, the approximate loads to apply to the ditcher and the inspections which should be made before the ditcher is put into service.

Section XXXI. PRESSURE TESTS

3–197. Cylinder Compression Test

a. Start the engine and run it at approximately one-half rated load until normal operating temperature is reached.

b. Stop the engine and remove the fuel pipes from the injector and fuel connectors.

c. Remove the injector and install a compression pressure gage.

d. Use a spare fuel pipe and fabricate a jumper connection between the fuel inlet and the return manifold connectors. This will permit fuel from the inlet manifold to flow directly to the return manifold.

e. Start the engine and run it at 600 rpm. Observe and record the compression pressure indicated on the gage. Do not crank the engine with the starting motor to obtain the compression pressure.

f. Perform Steps *b* through *e* on each cylinder. The compression pressure in any one cylinder should not be less than 425 psi (table 1-3) at 600 rpm. In addition, the variation in compression pressures between cylinders must not exceed 25 psi at 600 rpm.

3-198. Crankcase Pressure Test

a. Connect a manometer to the oil level dipstick opening in the cylinder block.

b. Refer to table 1-3 for proper readings at various engine speeds.

3-199. Air Box Pressure Test

a. Connect a manometer to an air box drain tube.

b. Check the readings obtained at various speeds with the specifications in table 1-3.

3-200. Exhaust Back Pressure Test

a. Remove the 1/8 inch pipe plug from an exhaust manifold and connect a manometer to the 1/8 NPT tapped hole.

b. Check the readings obtained at various speeds with the specifications in table 1-3.

3-201. Air Intake Restriction Test

a. Disconnect the cold weather starting aid tube from the top of the air inlet housing.

b. Attach a water manometer to the top of the air inlet housing.

c. Check the readings obtained at various speeds with the specifications in table 1-3.

d. This test is also an effective means of checking the operation of the air restriction indicator.

Section XXXII. ENGINE TUNE-UP

3-202. Adjust Valve Clearance (cold engine)

a. Clean the loose dirt from the exterior of the engine and remove the valve rocker covers. Then, cover any drain cavities in the cylinder head to prevent foreign material from entering.

b. Place the engine shut-off handle in the STOP position.

c. Rotate the crankshaft, by using the engine starter, until the injector follower is fully depressed on the cylinder to be adjusted. All of the exhaust valves may be adjusted, in firing order sequence, during one full revolution of the crankshaft. Refer to figure 3-119 for engine firing order and crankshaft rotation.

Caution: **The exhaust valve clearance is always adjusted at the push rod. DO NOT DISTURB THE EXHAUST VALVE BRIDGE ADJUSTING SCREW.**

d. Loosen the push rod lock nut.

e. Place a 0.017 inch feeler gage between the valve bridge and the valve rocker arm pallet (fig. 3-120). Adjust the push rod to obtain a smooth "pull" on the feeler gage.

f. Remove the feeler gage. Hold the push rod with a 5/16-inch wrench and tighten the lock nut with 1/2-inch wrench.

g. Recheck the clearance. At this time, if the adjustment is correct, the 0.015 inch feeler gage will pass freely between the valve bridge and the rocker arm pallet, but the 0.017 inch feeler gage will not pass through.

h. Check and adjust the remaining valves in the same manner as outlined above.

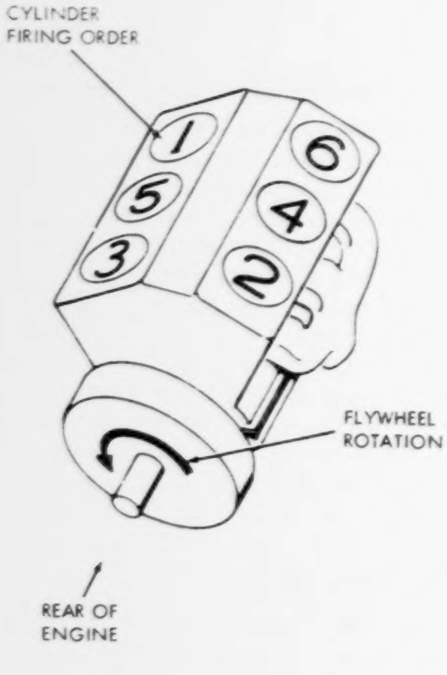


Figure 3-119. Engine firing order.

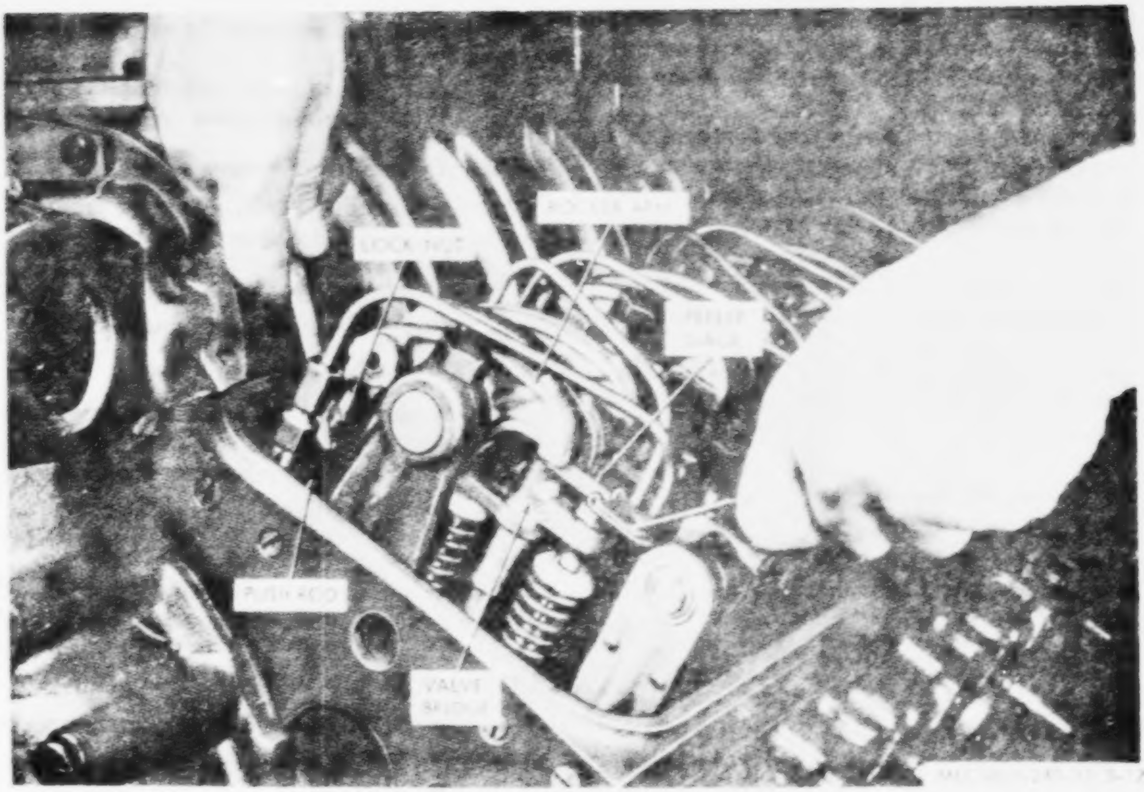


Figure 3-120. Valve clearance adjustment.

3-203. Adjust Valve Clearance (hot engine)

a. Maintaining the normal engine operating temperature is particularly important when making the final valve clearance adjustment. If the engine is allowed to cool off before setting any of the valves, the clearance when running at full load may become insufficient.

b. With the engine at normal operating temperature (160°—185° F.), recheck the exhaust valve clearance with the feeler gage. At this time, if the valve clearance is correct, the 0.013 inch feeler gage must pass freely between the valve bridge and the rocker arm pallet, but the 0.015 inch gage must not pass through. Readjust the push rod if necessary.

3-204. Time Fuel Injector

a. Clean the loose dirt from the exterior of the engine and remove the valve rocker covers. Then, cover any drain cavities in the cylinder head to prevent foreign material from entering.

b. Place the engine shut-off handle in the STOP position.

c. Rotate the crankshaft, by using the starting motor, until the exhaust valves are fully depressed on the particular cylinder to be timed.

d. Place the small end of the injector timing gage in the hole provided in the top of the injector body, with the flat of the gage toward the injector follower (fig. 3-121).

e. Loosen the push rod lock nut.

f. Turn the push rod and adjust the injector rocker arm until the extended part of the gage will just pass over the top of the injector follower.

g. Hold the push rod and tighten the lock nut. Check the adjustment and, if necessary, readjust the push rod.

h. Time the remaining injectors in the same manner as outlined above.

3-205. Position Injector Rack Control Levers

a. Properly positioned injector rack control levers, with the engine at full-load, will result in the following:

(1) Speed control lever at the maximum speed position.

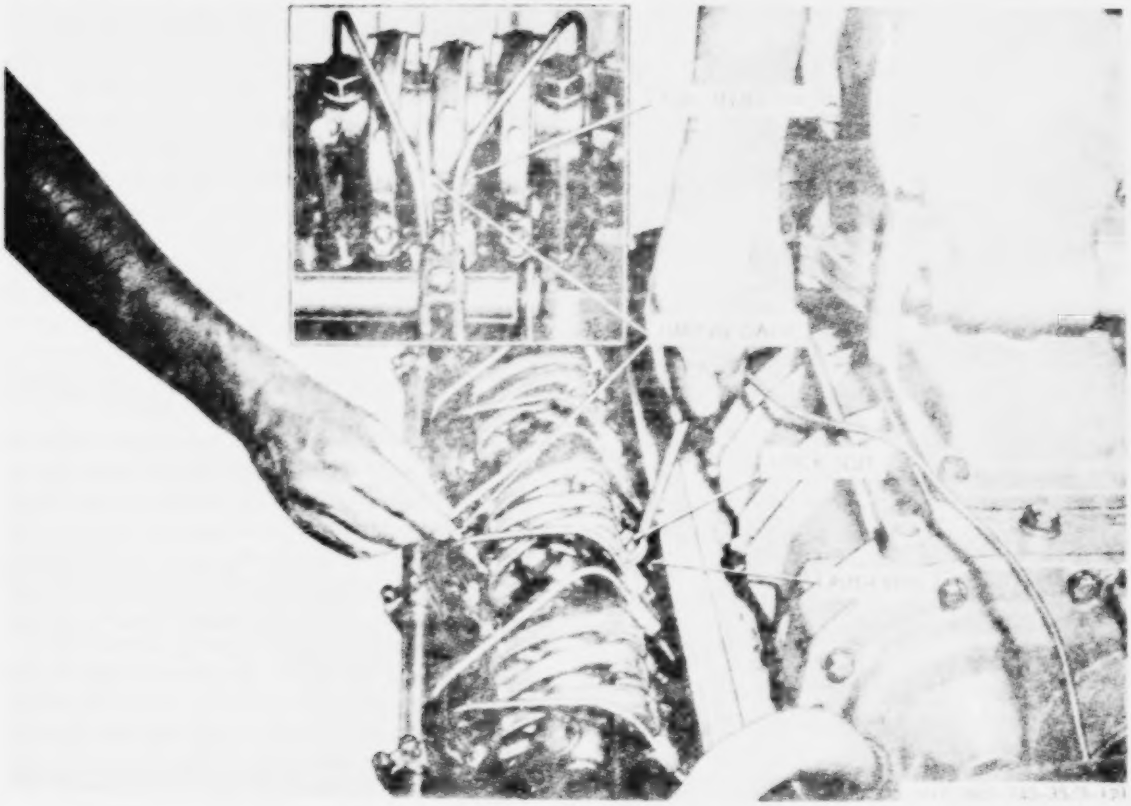


Figure 3-121. Fuel injector timing adjustment.

(2) Stop lever in the run position.

(3) High speed spring plunger is within 0.005 inch to 0.007 inch of its seat in the governor control housing.

(4) Injector fuel control racks in the full fuel position.

b. The letters R and L indicate the injector location in the right or left cylinder bank, viewed from the rear of the engine (fig. 3-119). The cylinders are numbered starting at the front of the engine on each cylinder bank. Adjust the No. 1L injector rack control lever first to establish a guide for adjusting the remaining left bank control levers.

(1) Disconnect any linkage attached to the governor stop lever.

(2) Loosen the buffer screw lock nut and back out the buffer screw approximately 5/8-inch.

(3) Remove the valve rocker covers.

(4) Loosen all the inner and outer injector rack control lever adjusting screws on both cylinder heads. Be sure all of the injector rack control levers are free on the injector control tubes.

(5) Check for any bind in the governor to control tube linkage by moving the linkage through its full range of travel with one hand on the stop lever and the other hand on one of the control tube levers.

(6) Remove the clevis pin from the fuel rod and the right cylinder bank injector control tube lever.

(7) Move the speed control lever to the maximum speed position.

(8) Move the governor stop lever to the "run" position and hold it in that position with light finger pressure. Turn the inner adjusting screw of the No. 1L injector rack control lever down until a slight movement in the governor stop lever is noted. Turn down the outer adjusting screw until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws (fig. 3-122).

(9) Move the governor stop lever back and forth a few times and note a "rotating" movement of the injector control rack when the stop lever is moved to the "run" position. Hold the stop lever in the "run" position and, using a screw driver, press downward on the injector con-

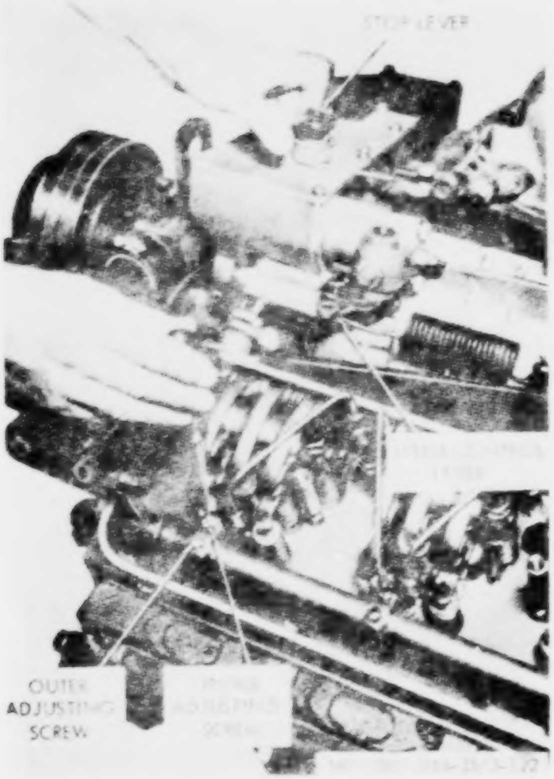


Figure 3-122. Positioning No. 1 injector rack control lever.

trol rack. The rack should then tilt downward and when the pressure of the screw driver is released, the control rack should "spring" back upward. Adjust the inner and outer adjusting screw to obtain this condition. At this point, the No. 1L injector rack control lever is fully adjusted. Tighten both the inner and outer adjusting screws and recheck adjustment.

(10) Remove the clevis pin from the fuel rod and the left bank injector control tube lever.

(11) Insert the clevis pin in the fuel rod and the right cylinder back injector control tube lever and position the 1R injector rack control lever as previously outlined in Steps (8) and (9).

(12) Insert the clevis pin in the fuel rod and the left bank injector control tube lever. Repeat the check on the 1L and 1R injector rack control lever as outlined in Step (9). Carefully observe and eliminate any deflection which occurs at the bend in the fuel rod where it enters the cylinder head.

(13) To adjust the remaining injector jack control levers, move the clevis pin from the fuel rods and the injector control tube levers, hold the injector control racks in the full-fuel position by means of the lever on the end of the control tube, and proceed as follows:

(*a*) Turn down the inner adjusting screw of the injector rack control lever until the screw bottoms (injector control rack in the full-fuel position).

(*b*) Turn down the outer adjusting screw of the injector rack control lever until it bottoms on the injector control tube.

(*c*) While still holding the control tube lever in the full-fuel position, adjust the inner and outer adjusting screws to obtain the same condition as outlined in step (9). Tighten the screws.

Caution: **Once the No. 1L and No. 1R injector rack control levers are adjusted, do not try to alter their settings. All adjustments are made on the remaining control racks.**

(14) When all of the injector rack control levers are adjusted, recheck their settings. With the control tube lever in the full-fuel position, check each control rack as in step (9). All of the control racks must have the same "spring" condition with the control tube lever in the full-fuel position.

(15) Insert the clevis pin in the fuel rods and the injector control tube levers.

CHAPTER 4

TRANSMISSION/TORQUE CONVERTER REPAIR INSTRUCTIONS

Section I. GENERAL

4-1. Components

This chapter contains instructions for repair of the transmission/torque converter assembly (fig. 4-1), and its accessories. Major components include the transmission/torque converter and the engine-driver power take-off assembly. Refer to figure 2-5 for an illustration of the transmission/torque converter piping system. The flow diagram (fig. 4-2) indicates hydraulic pressures within the system. Because of the complexity of the system, subassemblies are illustrated in separate exploded views. Figure 4-3 shows all major components in relation to one another and contains a key to figure numbers of all components. Since the power take-off assembly must be removed from the transmission before the transmission is removed from the ditcher, power take-off assembly repair instructions are covered in a separate section, section II, incorporating paragarphs 4-20 through 4-26.

Figure 4-1. Transmission/torque converter assembly cross section view.

(Located in back of manual)

Figure 4-2. Transmission/torque converter flow diagram.

(Located in back of manual)

Figure 4-3. Transmission/torque converter/power take-off sub-assembly groups, exploded view (reference numbers refer to sub-assembly figures).

(Located in back of manual)

4-2. Transmission Input (fig. 4-1, 4-3, 4-45)

A laminated steel flex disk assembly (27, fig. 4-1) connects the engine crankshaft with flywheel assembly (41), which is part of the transmission input drive. The inner bolt circle of the flex disk assembly bolts to a hub assembly which bolts to the engine crankshaft. The outer bolt circle of the flex disk assembly bolts to flywheel (41). The engine starter ring gear (26) is pressed onto the front end of the flywheel (41) outer diameter.

4-3. Torque Converter and Lockup Clutch (fig. 4-1, 4-3, 4-28)

a. Torque Converter.

(1) The three element torque converter is made up of pump (29, fig. 4-1), turbine (28) and stator assembly (40). These elements are cast aluminum with bladed oil passages curved in such a manner that the pump (input element) directs the oil flow through the turbine (output element) as directed by the stator (torque multiplying element) for torque multiplication. The turbine is splined to the shaft that transmits power to the splitter planetary carrier. The stator is supported by a free-wheel roller race splined to a stationary converter ground sleeve in such a way that the stator rotates freely on rollers in the direction of pump rotation, but locks against rotation in an opposite direction when torque multiplication is needed.

(2) The engine driven pump blades direct oil into the turbine blades, causing the turbine (28) to rotate with the pump. This oil returns to the pump through the stator vanes. Under heavy loads, which slow turbine (output) rotation, the stator (40) "locks up" on the one-way, overrunning clutch and redirects the oil to increase torque. This is the key to torque multiplication. As turbine (28) speed approaches pump speed, the stator (40) freewheels and the torque converter becomes a fluid coupling. The lockup clutch (see below) then locks up, making the converter a straight through, direct-drive unit.

b. Lockup Clutch (42, fig. 4-1)

(1) The lockup clutch (42, fig. 4-1) consists of a friction plate, splined to turbine (28), a clutch back plate and hydraulic-operated piston, attached to the input drive with a friction plate between them.

(2) When turbine speed approaches pump speed, oil pressure is directed to the piston to apply the clutch. This locks the input to the output for direct drive through the converter for economy of operation. Lockup is released briefly during shift changes to provide shockfree converter action for a smooth shift.

4–4. Torque Converter Housing and Power Take off (fig. 4–1, 4–3, 4–13, 4–4, 4–5)

a. Torque Converter Housing. Torque converter housing assembly (39, fig. 4-1) front fits the engine flywheel housing and its rear is bolted to the transmission main housing. On the top is a mounting pad for an engine-driven, heavy-duty, 8-bolt SAE power takeoff. Inside the housing are the torque converter elements, the input driven pump and the pump and power takeoff gear train.

b. Engine-driven Power Take off Gear. A drive gear is installed on the hub of the torque converter pump (39) and an idler gear (30) is installed on a spindle. The idler gear is positioned to mesh with the power takeoff driven gear. This idler gear rotates counterclockwise at 1.35 times engine speed.

c. Power Take-off. The power-take-off assembly (fig 4-4 and 4-5) consists of two attached sub-assemblies. The large, main sub-assembly is installed on the top of the transmission housing and its gear train is driven by the torque converter idler gear (30, fig. 4-1). The smaller sub-assembly is bolted to, and is gear-driven by the larger one. Lubricating oil under pressure flows from the transmission through the input and output shafts.

(1) The main sub-assembly (B, fig. 4-4) drives a hydraulic pump which supplies power to the crowd drive motor at the transfer case. An integral clutch pack within the sub-assembly is engaged or disengaged through actuation of a push-pull control located at the ditcher control station. Hydraulic pressure to operate the clutch pack is supplied through a line from the transmission main pressure port to a control valve at the ditcher control station that is operated to route flow to the clutch pack. When the clutch is disengaged, return fluid flows to the transmission oil pan.

(2) The small sub-assembly is spline connected to the two-section pump which supplies pressurized hydraulic fluid to operate the power steering assembly, hoist cylinders, boom guide cylinders, scraper cylinder, and conveyor shift motor. It drives constantly, whenever the engine is operating.

4–5. Splitter Planetary and Cluthes (fig. 4–1, 4–3, 4–36)

a. Splitter Planetary.

(1) The splitter planetary includes carrier (15, fig. 4-1), four pinions (19), sun gear in housing (7) and a ring gear assembly (11). The four pinions (19) rotate on rollers on spindles in the carrier (15). The carrier is part of the turbine output shaft (23). The sun gear (7) is splined to a splitter housing, and the ring gear splined to the shaft (24).

(2) The splitter planetary overdrive ratio is 1.00:1.42.

b. Splitter Clutches. There are two splitter clutches. The smaller diameter (direct-drive, low-clutch plates and one external-tanged plate. The splitter) clutch (1), has two internal splined larger diameter clutch (2) (over-drive, high-splitter) has three internal-tanged plates and three external-tanged plates. The low-splitter clutch has a piston and apply plate. The high-splitter clutch has a piston and a reaction plate. The internal-splined or tanged plates have a sintered bronze facing on steel and the external-tanged plates are steel.

c. Operation of Splitter Planetary and Clutches.

(1) For direct drive (low splitter), hydraulic pressure is directed against a piston. It compresses clutch plates (1), locking the planetary carrier (15) and sun gear (7) together.

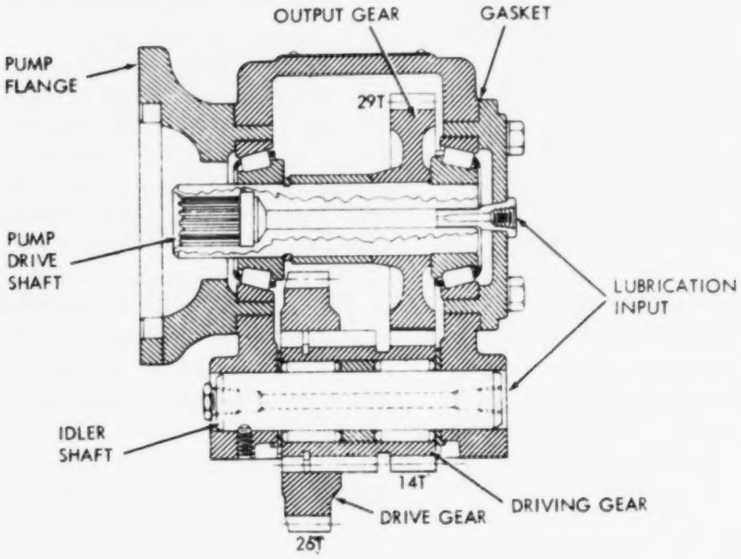
(2) With any two gear members locked together, the entire planetary must rotate together as a unit for direct drive.

(3) For overdrive (high splitter), hydraulic pressure is directed against a piston and compresses clutch plates (2) to hold sun gear (7) and housing stationary.

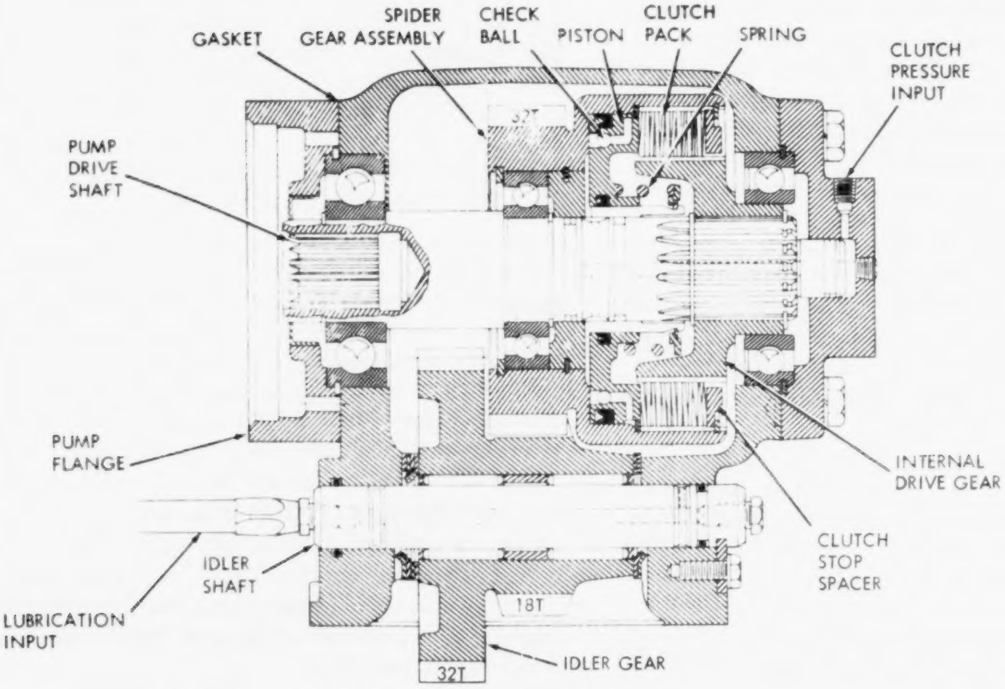
(4) The planetary pinions (19) rotate around the stationary sun gear (7), and overdrive the ring gear (11).

4–6. High-Range Clutch (fig. 4–1, 4–3, 4–40)

The high-range clutch (3, fig. 4-1) includes a housing assembly, piston assembly, four internal-splined clutch plates, three external-tanged plates, an apply plate, and thirteen piston return springs. The clutch housing is splined to the splitter output shaft (24). The external-splined plates engage the housing. The internal-tanged plates engage splines on intermediate-range carrier assembly (18). Hydraulic pressure is applied


OUTPUT GEAR
GASKET
PUMP FLANGE
29T
PUMP DRIVE SHAFT
LUBRICATION INPUT
IDLER SHAFT
14T
DRIVING GEAR
DRIVE GEAR
26T

A. MAIN AND STEERING PUMP DRIVE


SPIDER GEAR ASSEMBLY
CHECK BALL
PISTON
CLUTCH PACK
SPRING
GASKET
CLUTCH PRESSURE INPUT
32T
PUMP DRIVE SHAFT
PUMP FLANGE
INTERNAL DRIVE GEAR
CLUTCH STOP SPACER
IDLER SHAFT
LUBRICATION INPUT
18T
IDLER GEAR
32T

B. CROWD DRIVE PUMP DRIVE

MEC3805-240-35/4-4

Figure 4-4. Power-take-off assembly, cross section of main sub-assembly.

to the high-range clutch piston and the clutch plates are locked together between the piston and apply plate. This locks the intermediate-range carrier (18) and sun gear (10) together. As a result of the interconnection of the low-range planetary carrier (17) with the intermediate-range carrier (18), both planetaries are locked up. Rotation of the splitter output shaft (24) is transmitted to low-range planetary carrier assembly (17) and transmission output shaft (25).

4-7. Intermediate-Range Planetary and Clutch (fig. 4-1, 4-3, 4-22, 4-24)

a. Intermediate-Range Planetary.

(1) The intermediate-range planetary gear set consists of carrier (18, fig. 4-1), six pinions (22), sun gear (7), and ring gear (14). The six pinions rotate on rollers on spindles in the carrier (18). The carrier is splined to low-range planetary ring gear (13) and supported at its forward end by splined engagement with the high-range clutch plates (3). The sun gear (10) is splined to the splitter output shaft (24). Ring gear (14) is splined into the inner circumference of clutch plates (4). A welded band around ring gear (14) prevents end movement.

(2) A 2.00:1 planetary gear ratio is used in the transmission intermediate-range planetary.

b. Intermediate-Range Clutch. This clutch consists of a reaction housing, three internal-splined plates, two external-tanged plates, and an apply plate compressed by a Belleville spring and piston in a piston housing. The external-tanged plates and apply plate engage the stationary reaction housing. Internal-splined rotating plates engage intermediate-range ring gear (14).

c. Intermediate-Range Planetary and Clutch Operation.

(1) Hydraulic pressure applied to the clutch piston compresses the return spring against the clutch apply plate which compresses alternately stacked clutch plates and against the stationary reaction housing. This holds ring gear (14) stationary.

(2) Intermediate-range sun gear (10) rotates pinions (22) within stationary ring gear (14). The rotation of the pinions within the ring gear drives carrier (18) which is splined to and drives low-range ring gear (13). Low-range sun gear (9) rotates at the same speed as does the intermediate-range sun gear (10). The combination of the low-range sun gear (9) and ring gear (13) rotating at different speeds drives the low-range carrier (17) and transmission output shaft (25).

4-8. Low-Range Planetary and Clutch (fig. 4-1, 4-3, 4-19 & 4-22)

a. Low-Range Planetary.

(1) The low-range planetary gear set consists of carrier (17), four pinions (21), sun gear (9) and ring gear (13). Pinions (21) rotate on rollers on spindles in carrier (17), which is splined to the output shaft (25). The ring gear (13) splines into internal-splined plates of the low-range clutch (5). The ring gear (13) is splined also to the intermediate-range carrier (18) and to the shaft of reverse-range sun gear (8) for compounding in intermediate and reverse ranges.

(2) A low-range speed reduction ratio of 4.00:1 is used in the transmission.

b. Low-Range Clutch. The low-range clutch pack (5) resembles the other clutch packs. The same piston housing serves both the low-and reverse-range clutches.

c. Operation of Low-Range Clutch and Planetary. When hydraulic pressure is directed to the clutch piston, low-range ring gear (13) is held stationary. Pinions (21), driven by sun gear (9), are forced to rotate within the ring gear (13). The rotation of the pinions (21) within the stationary ring gear (13) rotates carrier assembly (17) and the transmission output shaft (25).

4-9. Reverse-Range Planetary and Clutch (fig. 4-1, 4-3, 4-17, 4-19)

a. Reverse-Range Planetary.

(1) The reverse-range planetary consists of carrier (16, fig. 4-1), six pinions (20), sun gear (8) and ring gear (12). The pinions rotate on rollers on spindles in the carrier. The carrier splines (16) to transmission output shaft (25). The ring gear (12) is splined to reverse-range, internal-splined clutch plates in the clutch pack (6).

(2) The transmission has a reverse-range planetary speed reduction ratio of 4.769:1.

b. Reverse-Range Clutch. The reverse-range clutch pack resembles the other clutch packs. The same piston housing serves both the low-and reverse-range clutches.

c. Operation of Reverse-Range Planetary and Clutch. When hydraulic pressure is applied to the clutch piston, planetary ring gear (12) is held stationary. Sun gear (8), driven in reverse by the action of the low-range planetary ring gear (13), forces reverse pinions (20) to rotate within the stationary, reverse-range ring gear (12). The pinions drive the reverse-range carrier (16) and transmission output shaft (25).

4-10. Output Section (fig. 4-1, 4-3 and 4-8)

The output shaft (25, fig. 4-1) is in line with the input and range gearing. The output section includes cover (31), a bearing retainer and the output flange (32). Cover (31) encloses the rear end of the transmission and retains the range gearing and clutch components. The retainer supports two bearings which, in turn, support the transmission output shaft (25).

4-11. Oil Pan and Screen (fig. 4-1, 4-3 and 4-11)

The oil pan (35, fig. 4-1) is the oil sump of the transmission. It also encloses the main control valve assembly (33) and oil screen (36). The oil screen is a 60 x 40 mesh, cylindrical screen and is easily accessible for removal and cleaning.

4-12. Oil Pumps

a. Charging Oil Pump (fig. 4-1, 4-2, 4-3 and 4-39). A dual-type oil pump (37, fig. 4-1) supplies oil pressure to both the main circuit and to the converter circuit. The oil pump drive gear is driven by the converter pump hub. This results in the oil pump being driven at engine speed. The oil pump drive gear meshes with two oil pump driven gears and delivers oil at two separate outlets.

b. Scavenge Pump (fig. 4-1, 4-2, 4-3 and 4-33). A gear-type pump (38, fig. 4-1) scavenges the converter housing. The scavenge pump drive gear is driven at 1.59 times engine speed by the power take-off drive gear which is bolted to the converter pump. The scavenge pump internal drive gear meshes with one pump-driven gear to scavenge the converter housing.

4-13. Main Control Valve Assembly (fig. 4-2, 4-3, 4-14)

a. Valve Body Assembly. The main control valve body assembly (33, fig. 4-1), located in the oil pan, controls main oil pressure and lockup engagement automatically. In addition, it contains the manual selector valve by which shifts are made to neutral, six forward speeds and reverse. Included in the assembly are a main regulator valve, main regulator pilot valve, lockup shift valve, flow valve, and the selector valve assembly. Refer to figure 4-2.

b. Internal Valves. All valves, except the manual selector valve assembly, are spool-type valves. The selector valve is a tubular type with internal passages. The assembly bolts to the bottom of the transmission housing upon an oil transfer plate assembly (para 4-17).

(1) *Main-Pressure Regulator Valve (35, fig. 4-14).* Main oil pressure in the hydraulic circuit is regulated by the movement of a spool-type, spring-loaded valve located in the control valve assembly, which is bolted to the bottom of the transmission housing inside the oil pan. Its movement opens and closes ports through which oil may flow. The pressure level which this valve maintains must be sufficient to balance the forces on the opposite end of the valve. The forces at the opposite end of the valve are spring loaded, and hydraulic pressure regulated by the pilot valve. The function and the movement of the valve is fully automatic.

(2) *Lockup Shift Valve (30, fig. 4-14).*

(*a*) The flow of oil to and from the lockup clutch piston cavity is controlled by the lockup shift valve. When this spool-type valve moves in its bore, it opens and closes ports which determine whether the lockup clutch is engaged. This valve is located in the control valve assembly.

(*b*) Governor pressure, acting at the upper end of the valve, pushes the valve downward to engage the lockup clutch when speed is sufficient for lockup operation. In overdrive (second, fourth and sixth gear) operation, overdrive clutch pressure is directed to the lower end of the lockup plug. This compresses the lockup shift valve spring and raises the governor speed at which lockup occurs. This action offsets the increase in governor speed during overdrive operation.

(3) *Flow Valve (31, fig. 4-14).* Operating in conjunction with the lockup valve is the spool-type flow valve. It is located in the control valve assembly. Its function is to override the lockup shift valve so as to disengage the lockup clutch, momentarily placing the transmission in converter operation when shifts are made. The movement of the valve, which is automatic, exhausts lockup clutch apply to sump.

(4) *Pilot Valve (28, fig. 4-14).*

(*a*) The main-pressure regulator valve (above) is controlled by the pilot valve. Located in the same bore as the main-pressure regulator valve, the pilot valve regulates main pressure in the cavity between the two valves. Its purpose is to modulate main pressure and provide a pressure reduction to give two pressure schedules.

(*b*) At the end of the pilot valve opposite the spring, two hydraulic forces act upon the valve to move it against its spring pressure and thus reduce main pressure. The two forces are forward and neutral knockdown pressure and governor pressure. Thus, during forward, neutral or high-speed operation, main pressure is reduced.

(5) *Manual Selector Valve (18, fig. 4-14).*

(*a*) Located in the control valve assembly, inside the oil pan, the manual selector valve is a slotted shaft type with two integral passages drilled lengthwise. It has eight positions which are manually selected by the operator, and is connected by linkage to a control near the operator. Its movement to each of the eight positions determines the range in which the transmission operates. Each position directs oil to clutches requiring engagement for that particular range.

(*b*) Another function of the valve is to direct oil pressure to the pilot valve in neutral and all forward ranges. In reverse range, the manual selector valve cuts off oil pressure to the pilot valve. Spring-loaded detent balls accurately locate the selector valve in each shift position and restrain its movement until manually shifted.

4-14. Converter-Out Pressure Regulator Valve (4, fig. 4-16)

This valve is located in the main transmission housing. The valve works against spring pressure and regulates oil pressure coming from the converter through the cooler. Therefore, converter pressure is regulated by this valve, plus any restriction in the cooler and converter-out oil line.

4-15. Converter Pressure Regulator Valve Assembly (fig. 4-12)

a. Converter-in Pressure Regulator Valve (28, fig. 4-12). This umbrella-type valve is located in the converter and lubrication pressure regulator valve assembly, which is bolted to the transmission housing, inside the oil sump pan. Its purpose is to limit converter-in pressure so that it will not exceed lockup pressure and thus prevent the lockup clutch from engaging. Converter pressure is limited to 100 psi during converter operation and 35 psi during lockup operation. Any pressure overages that might occur, such as during cold starts, are exhausted to sump.

b. Lubrication Regulator Valve (19, fig. 4-12). This spring loaded, spool-type valve is located in the converter and lubrication pressure regulator valve assembly, inside the oil sump pan. Lubrication pressure forces the valve to move against its spring pressure, relieving the lubrication circuit to the converter-in circuit.

4-16. Fluid Velocity Governor (fig. 4-40)

a. The fluid velocity governor provides the pressure necessary to assist in the regulation of main pressure, and to actuate the lockup valve to secure lockup of the torque converter. The fluid velocity governor consists of two simple parts. One part is the collector ring (24, fig. 4-40) which is secured to high-range clutch housing assembly (32) and turns at splitter output speed. The other part is pitot tube (10) which is a stationary tube, bolted to high-range clutch diaphragm (11), with the open end facing opposite the rotation of the governor collector ring.

b. When the transmission is in operation, oil is supplied to the collector ring, keeping it filled. Oil is retained in the collector ring by centrifugal force as the ring turns. The pitot tube, being in and facing the moving oil, receives the oil and directs it to the pilot valve and the lockup valve. Pressure in the pitot line is proportional to the velocity of the oil striking the open end of the pitot tube. Pitot pressure, if it exceeds main pressure, opens a check valve leading to the main oil pressure circuit. This prevents pitot pressure from appreciably exceeding main pressure.

4-17. Oil Transfer Plate Assembly (fig. 4-1, 4-2, 4-3, 4-14)

The oil transfer plate is an aluminum casting with cast channels to direct oil from valves mounted upon it to various passages in the transmission housing. The assembly mounts on the bottom surface of the transmission housing with its channeled side against the housing bottom. The plate, when installed, retains a discharge tube in a vertical position at the right-front corner of the oil pan.

4-18. Hydraulic System in Action (fig. 4-2)

a. Neutral Hydraulic Action.

(1) When the selector valve is shifted to the neutral position while the engine is idling, the hydraulic system responds as described in (2) through (11), below.

(2) Oil is drawn from the sump by the 2-section charging oil pump (37, fig. 4-1) and forced into the hydraulic system through two circuits. One circuit is the converter-in circuit; the other is the main pressure circuit. Pressure to the converter is regulated by the converter-in pressure regulator valve. Main pressure is regulated by the main-pressure regulator valve in combination with the pilot valve.

(3) Main oil pressure to the flow valve flows around the lands at the upper end of the flow valve and on to the lockup valve where it is blocked. Main oil also flows through an orifice and through a check valve to the opposite end of the flow valve; thus, main pressure is equal on each end of the valve. Because of a slightly larger area on the lower end of the valve, main pressure holds it in a closed (upward) position.

(4) Continuing on to the manual selector valve, main oil pressure fills the plugged, lengthwise passage within the valve. Range clutch oil pressure is exhausted to sump through the other lengthwise passage which is open at one end.

(5) In neutral position, the manual selector valve has two outlets: the forward and neutral knockdown circuit which leads to the pilot valve and the splitter direct drive clutch apply passage.

(6) In neutral the 2-section charging oil pump supplies oil pressure for the converter-in circuit to charge the torque converter. The converter pressure regulator valve regulates the pressure at 35 psi for lockup operation and 100 psi for converter operation. During lockup operation, lockup pressure moves the lockup plug and reduces the valve spring pressure, causing the umbrella-type valve to open more readily, and reduce the converter-in pressure to 35 psi. Oil from the converter flows through the cooler to the converter-out pressure regulator. If the oil pressure from the cooler becomes excessive, the valve will open against its spring pressure and exhaust to sump.

(7) In neutral, there will be a pressure in the pitot (governor) line that is proportional to the speed of the pitot collector ring which is driven by the turbine. At engine idle speed, this pressure will exert only a negligible force on the pilot valve and on the lockup valve.

(8) As turbine speed increases, the pitot collector ring rotates faster and builds up pitot pressure. The rise in pitot pressure moves the pilot valve against its spring, reducing main pressure in the cavity between the pilot valve and the main-pressure regulator valve. The reduced main pressure in this cavity, in turn, causes a reduction in the main pressure controlled by the regulator valve. Excessive pitot pressure is exhausted to main pressure through a check valve.

(9) The transmission lockup clutch disengages automatically to place the transmission in converter operation during each range shift. Except during range shifting operation, pitot pressure controls the operation of the lockup clutch. As pitot pressure rises, it forces the lockup valve to move against its spring pressure and opens main pressure to the lockup clutch apply line. Lockup clutch apply pressure flows through the flow valve and on to the lockup clutch where the converter pump is locked to the converter turbine. During a range shift, a momentary drop in pressure at the larger end of the valve allows the flow valve to move and cut off lockup pressure; the lockup clutch apply line pressure is exhausted to sump.

(10) In converter operation, with the lockup valve closed by its spring pressure, lubrication pressure from the main-pressure regulator valve flows to the lubrication pressure regulator valve where it is regulated to 100 psi. When the lubrication pressure regulator valve opens, oil flows into the converter-in passage supplementing the oil flow from the charging oil pump if converter-in pressure is below 100 psi. With converter-in pressure of 100 psi, excess oil from the lubrication system is exhausted to sump through the umbrella-type converter-in pressure regulator valve. However, when the lockup valve is opened against its spring pressure, the valve cuts off the lubrication circuit segment leading to the lubrication regulator valve. In this case, the lubrication circuit is regulated by the main-pressure regulator valve. Each of the lubrication passages which supply the clutch and gear package has an orifice to restrict the flow of oil.

b. First-Gear Hydraulic Action.

(1) In the first gear, hydraulic conditions are the same as described in *a* above, except as follows: the manual selector valve is in first-gear position and main oil pressure is directed to the low-range clutch apply line, the low clutch pressure circuit leading to the lockup clutch, the splitter direct clutch apply line and the forward and neutral knockdown line.

(2) As in neutral, lockup will occur as turbine speed increases.

c. Second-Gear Hydraulic Action.

(1) In second gear, hydraulic conditions are the same as described in *a* above, except as follows: the manual selector valve is in second-gear position and main oil pressure is directed to the low-range clutch apply line, the splitter overdrive clutch apply line and forward and neutral knockdown line. In this position the manual selector valve exhausts all other clutch apply lines.

(2) As in neutral, lockup will occur as turbine speed increases.

d. Third-Gear Hydraulic Action.

(1) In third gear, hydraulic conditions are the same as described in *a* above, except as fol-

lows: the manual selector valve is in third-gear position and main pressure is directed to the intermediate-range clutch apply line, the splitter direct clutch apply line, and the forward and neutral knockdown line.

(2) In this position the manual selector valve exhausts all other clutch apply lines.

(3) As in neutral, lockup will occur as turbine speed increases.

e. Fourth-Gear Hydraulic Action.

(1) In fourth gear, hydraulic conditions are the same as described in *a* above, except as follows: the manual selector valve is in fourth-gear position and directs main-pressure to the intermediate-range clutch apply line, the splitter overdrive clutch apply line, and the forward and neutral knockdown line. In this position the manual selector valve exhausts all other clutch apply lines.

(2) As in neutral, lockup will occur as turbine speed increases.

f. Fifth-gear Hydraulic Action.

(1) In fifth gear, hydraulic conditions are the same as described in *a* above, except as follows: the manual selector valve is in fifth-gear position and directs main oil pressure to the high-range clutch apply line, the splitter direct clutch apply line and the forward and neutral knockdown line.

(2) In this position, the manual selector valve exhausts the intermediate range clutch apply line to sump. The splitter overdrive clutch is also exhausted to sump through the manual selector valve.

(3) As in neutral, lockup will occur as turbine speed increases.

g. Sixth-gear Hydraulic Action.

(1) In sixth gear, hydraulic conditions are the same as described in *a* above, except as follows: the manual selector valve is in sixth-gear position and directs main oil pressure to the high-range clutch apply line, the splitter overdrive clutch apply line, and the forward and neutral knockdown line. In this position the manual selector valve exhausts the splitter direct clutch apply line to sump.

(2) As in neutral, lockup will occur as turbine speed increases.

h. Reverse-Gear Hydraulic Action. In reverse gear, hydraulic conditions are the same as described in *a* above, except as follows: the manual selector valve is in reverse-gear position and directs main oil pressure to the reverse-range clutch apply line and the direct drive clutch apply line. In this position, all other clutch apply lines are exhausted to sump. The forward and neutral knockdown line is also exhausted, which causes the pilot valve to move toward the main-pressure regulator valve, increasing main pressure. Thus, a higher main pressure is provided for reverse-range operation. Lockup can occur in reverse-range operation if sufficient speed is attained.

4–19. Torque Paths

a. Table 4-1 shows which gears and shafts are rotating, which free wheel, and which are locked up when the clutches are actuated. Note that the lockup clutch is not included in the table. Actuation of lockup clutch is controlled by governor (pitot) pressure, and is automatic when torque converter turbine speed approaches torque converter pump speed.

b. Note in table 4-1 that at least two clutches (the lockup clutch excepted) must be engaged in order for torque to be transmitted to the output shaft. It is assumed that the engine is operating at normal working torque output and speed. If the engine is idling, no torque will be transmitted to the output shaft even if two clutches are engaged.

Table 4-1. Transmission Clutch and Gear Train Actuation

	*Number		Neutral	1	2	3	4	5	6	Reverse
Clutch Pack	1	Splitter Direct-drive	L	L	O	L	O	L	O	L
	2	Splitter Overdrive	O	O	L	O	L	O	L	O
	3	High-range	O	O	O	O	O	L	L	O
	4	Intermediate-range	O	O	O	L	L	O	O	O
	5	Low-range	O	L	L	O	O	O	O	O
	6	Reverse-range	O	O	O	O	O	O	O	L
Sun Gear	7	Splitter	T	T	S	T	S	T	S	T
	8	Reverse-range	F	S	S	F	F	T	T	T
	9	Low-range	F	T	T	T	T	T	T	T
	10	Intermediate-range	F	F	F	T	T	T	T	F

Table 4-1. Transmission Clutch and Gear Train Actuation—Continued

	*Number		Neutral	1	2	3	4	5	6	Reverse
Ring Gear	11	Splitter	T	T	T	T	T	T	T	T
	12	Reverse-range	F	F	F	F	F	T	T	S
	13	Low-range	F	S	S	T	T	T	T	T
	14	Intermediate-range	F	F	F	S	S	T	T	F
Planet Carrier	15	Splitter	T	T	T	T	T	T	T	T
	16	Reverse-range	F	F	F	F	F	T	T	T
	17	Low-range	F	T	T	T	T	T	T	T
	18	Intermediate-range	F	S	S	T	T	T	T	F
Planet Pinions	19	Spliter	S	S	T	S	T	S	T	S
	20	Reverse-range	F	F	F	F	F	S	S	T
	21	Low-range	F	T	T	T	T	S	S	T
	22	Intermediate-range	F	F	F	T	T	S	S	F
Shaft	23	Turbine	T	T	T	T	T	T	T	T
	24	Splitter Output	T	T	T	T	T	T	T	T
	25	Output	S	T	T	T	T	T	T	T

*Refer to Fig. 4-1. T = Transmitting torque during rotation
L = Locked F = Free rotation (no torque transmission)
O = Open S = Not rotating

Section II. POWER TAKE-OFF SUB-ASSEMBLY REPAIR INSTRUCTIONS

4-20. Removal

Refer to figure 2-3 and remove power take-off assembly.

4-21. Disassembly

Refer to figure 4-5 and disassemble PTO in the numerical sequence shown, following special instructions below.

Note. Prior to disassembly, remove heavy deposits of dirt, grease, oil, or road mud from the exterior of the PTO. Locate and mark with a sharp-pointed tool any moist oil spots or any unusually heavy oil-soaked road mud, possibly indicating cracks or holes otherwise difficult to detect. Complete the cleaning of the exterior either by steam cleaning or by hand-brushing. Use drycleaning solvent or volatile mineral spirits as a cleaning agent for either spot cleaning or total immersion cleaning. Do not use gasoline, caustic soda, or detergent cleaners.

Note. Cover transmission opening after removing power take-off.

a. Needle Bearings (55 and 57).

(1) Drive idler shaft (23) partially from main sub-assembly housing, using a drift bar 3 7/8 inches long by 1 inch in diameter. Stop driving action when both ends of drift bar are clear of the inside bossed bearing surfaces of the housing, while supporting with one hand the now freed idler gear (51), spacer bearing (58), and needle bearing sets.

(2) Remove bar with its supported parts intact; cover with a clean cloth.

b. Ball Bearing (75) and Piston Ball Assembly (89).

(1) Press pump drive shaft (76) toward pump-flange end until ball bearing (75) clears the housing.

(2) Remove ball bearing and piston ball assembly (89), covering with a clean cloth.

c. Internal Drive Gear (72). Utilize 3/8-24 puller holes in drive gear to remove.

d. Needle Bearings (29).

(1) Drive idler shaft (23) partially from small sub-assembly housing, using a drift bar 2 5/8 inches long x 15/16 inch in diameter. Stop driving action when both ends of drift bar are clear of the inside bossed bearing surfaces of the housing; support with one hand the now-freed driving gear (26), spacer bearing (28), and needle bearing sets.

(2) Remove bar with its supported parts intact; cover with a clean cloth.

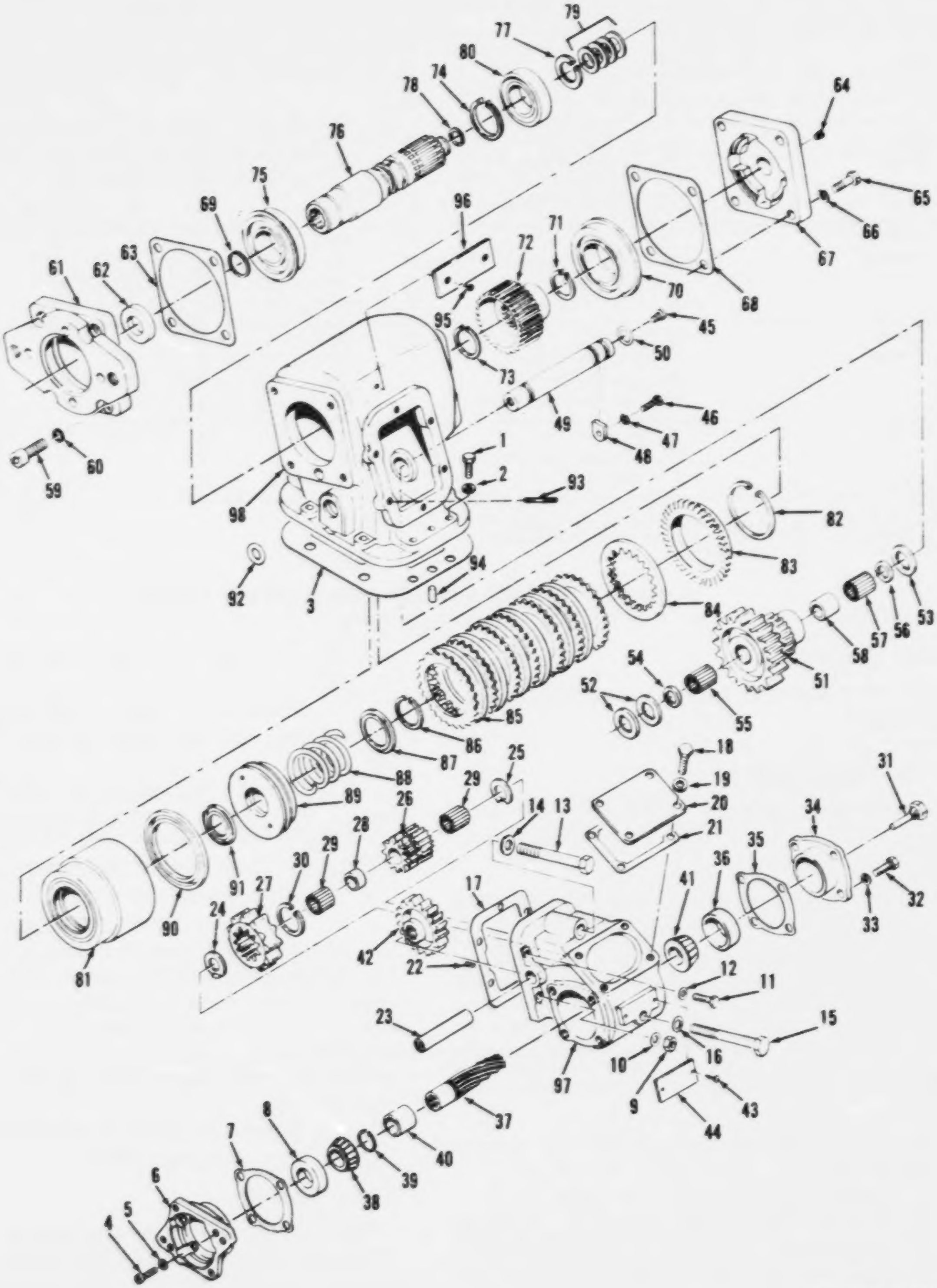
4-22. Cleaning

***Caution:* Bearings require special handling. Cleaning, inspection, and preparation for use of all ball or roller bearings are covered in TM 9-237.**

a. Use round brushes to clean boring holes or other circular openings and square or rectangular brushes on flat surfaces.

b. Clean each part thoroughly and individually.

Note. Clean lubrication holes in shafts.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MEC3805-240-35/4-5

1 Screw, cap, hex head 7/16-14 x 1 1/2 (8 rqr)
2 Washer, lock 7/16 (8 rqr)

*3 Gasket .010)
Gasket .020)—(as rqr)
Gasket .015)

Figure 4-5. Power take-off assembly, exploded view.

4 Screw, cap, Allen 5/16-18 x 1 1/2 (4 rqr)
5 Washer, lock, hy collar 5/16 (4 rqr)
6 Flange, pump S.A.E. type B2-bolt
*7 Gasket, bearing cap .010) (as rqr)
Gasket, bearing cap. 020)
8 Cup, bearing
9 Nut, hex 3/8-24 (2 rqr)
10 Gasket, copper bolt (2 rqr)
11 Screw, cap, hex head 3/8-16 x 1 1/4 (2 rqr)
12 Gasket, copper bolt (2 rqr)
13 Screw, cap, hex head 3/8-16 x 4
14 Gasket, copper bolt
15 Screw, cap, hex head 3/8-16 x 7
16 Gasket, copper bolt
*17 Gasket, mounting .010) (as rqr)
Gasket, mounting .020)-
18 Screw, cap, hex head 5/16-18 x 5/8 (4 rqr)
19 Washer, lock 5/16 (4 rqr)
20 Plate, cover
21 Gasket, cover
22 Screw, set, 1/4-20 x 1/2
23 Shaft, idler
24 Washer, thrust
25 Washer, thrust
26 Gear, driving
27 Gear, input
28 Spacer, bearing
29 Roller, needle (38 rqr)
30 Ring, snap
31 Reducer, extension
32 Screw, cap, hex head 5/16-18 x 1 (4 rqr)
33 Washer, lock 5/16 (4 rqr)
34 Cap, bearing
35 Gasket, bearing cap .010) (as rqr)
Gasket, bearing cap .020)—
36 Cup, bearing
37 Shaft, pump drive
38 Cone, bearing
39 Lock ring
40 Spacer
41 Cone, bearing
42 Gear, output
43 Screw, drive (2 rqr)
44 Plate, name
45 Plug, pipe
46 Screw, cap, hex head 5/6-18 x 3/4
47 Washer, lock 5/16
48 Plate, retaining
49 Shaft, idler
50 Packing, preformed
51 Gear, idler 32T
52 Washer, thrust (2 rqr)
53 Washer, thrust
54 Washer, bearing
55 Bearing, needle (21 rqr)
56 Washer, bearing
57 Bearing, needle (21 rqr)
58 Spacer, bearing
59 Screw, cap, Allen 5/16-18 x 1 1/2 (4 rqr)
60 Washer, lock, hy collar 5/16 (4 rqr)
61 Flange, pump
62 Trap, oil
63 Gasket, bearing cover .020
64 Plug, pipe 1/8-27 NPT
65 Screw, cap, hex head 1/2-13 x 1 1/2 (4 rqr)
66 Washer, lock 1/2 (4 rqr)
67 Cover, bearing
68 Gasket, bearing cover .020
69 Lock ring
70 Bearing, ball
71 Lock ring
72 Gear, internal drive
73 Lock ring
74 Lock ring
75 Bearing, ball
76 Shaft, pump drive
77 Lock ring
78 Ring, piston (2 rqr)
79 Ring, piston (4 rqr)
80 Bearing, ball
81 Spider gear assembly
82 Lock ring
83 Spacer, clutch stop
84 Disc, bronze (7 rqr)
*85 Disc, opposing (7 rqr)
*86 Lock ring
87 Spring retainer
88 Spring
89 Piston and ball assembly
90 Ring, block vee
91 Ring, block vee
92 Packing, preformed
93 Stud, 3/8-16 x 1 5/8 (2 rqr)
94 Pin, dowel (2 rqr)
95 Screw, drive (2 rqr)
96 Plate, name
97 Housing, small sub-assembly
98 Housing, main

*Refer to Note, Caution or Warning in text or other instruction.

Figure 4-5—Continued

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c. Remove all deposits of hardened oil, lacquer, and dirt. Give particular attention to small oil holes in gears, bearings, and thrust washers.

d. Remove gaskets or parts of gaskets from surfaces before cleaning.

e. Rinse parts in dry-cleaning solvent or volatile mineral spirits to remove any foreign matter remaining after initial cleaning. Use an agitated solvent bath to rinse small parts.

f. Dry rinsed parts with compressed air.

4-23. Inspection and Repair

a. PTO Housings, Flanges, and Bearing Caps.

(1) Inspect castings for small holes or cracks marked during pre-cleaning. If holes or cracks are small, weld in accordance with TM 9-237.

(2) Inspect all machined surfaces for wear, brinelling, or spalling. If machined surfaces are worn, use a honing stone or crocus cloth to recondition the surface. If defects cannot be repaired with a hone, replace.

b. Bearings and Bearing Cups.

(1) Inspect all bearings for freedom of movement, flattened surfaces, scoring, pitting and other flows. Replace all bearings that have any of these obvious defects, as well as those showing evidence of sticking or excessive dirtiness.

Caution: **Do not spin dry bearings that are badly scored or pitted.**

(2) Check fit of ball bearings in housings. All bearings have a permissible clearance of 0.005 inch between outer race and housing.

c. Gears and Shafts.

(1) Inspect the machined surfaces of each shaft on which gears, sleeves, or bearings ride. Very slight abrasions may be removed with a hone. Replace shafts that are pitted or scored. Inspect splines for evidence of scoring, galling, or twisting. Replace shafts if twisted, cracked, or scored. Clean lubrication holes in shafts.

(2) Inspect all gears for damage or wear at the gear teeth. Check hubs of gears for cracks. Replace badly worn or damaged gears. Repair slight abrasions on gear teeth with a hone and crocus cloth.

d. Clutch Discs, Bronze (84).

(1) Inspect for distortion and wear. Replace if bronze surface is worn below spiral face grooves.

(2) Inspect internal clutch teeth to determine freedom from burrs and free sliding on spline.

e. Clutch Discs, Steel (85).

(1) Inspect for wear, heat distortion, and burrs on external teeth.

(2) Inspect for flattening of discs. Replace if not concave.

Note. I. D. of steel clutch discs is approximately 1/64 inch higher than O. D. if measured from a flat surface.

f. Packing, Preformed (O-Rings) (50, 92); Gaskets (7, 21, 17, 35, 63, 68).

(1) Replace.

(2) Soak in a light grade of lubricating oil for at least 30 minutes before reassembly.

g. Piston and Ball Assembly (89).

(1) Inspect piston for freedom of movement, scoring, pitting, and other flaws. Replace if badly scored or pitted, or if free movement is impaired. Repair slight abrasions with a hone and crocus cloth.

(2) Inspect piston ball bearings to determine looseness in piston. Replace assembly if damage or wear restricts free movement of balls.

(3) Replace block vee rings (90, 91).

Note. Do not remove piston rings (78, 79) from shaft unless broken, damaged, of fail to project above shaft diameter.

h. Oil Trap. Replace if inner sealing lip is damaged or worn.

i. Hardware. Inspect all hardware for damaged threads and rusted condition. Replace all defective hardware.

4-24. Reassembly

Reassemble sub-assemblies in reverse of numerical sequence shown in figure 4-5, following special instructions below. Refer to paragraph 1-4 for bolt, nut, and screw torques.

a. Reinstall idler gear (51), spacer bearing (58), and needle bearing sets (55, 57) on drift bar before reassembling in reverse of the order cited in paragraph 4-21 *a* (1).

b. Reassemble ball bearing (75) and piston ball assembly (89) in reverse of the order cited in paragraph 4-21 *b*.

c. Install block vee rings with sharp edges facing toward pump flange (61).

d. Reassemble clutch pack, alternating bronze (84) between steel discs (85), with steel disc first in order.

Caution: **Assemble steel discs with concave sides facing clutch stop spacer (83).**

e. Reinstall idler gear (26), spacer bearing (28), and needle bearing sets (29) on drift bar before reassembling in reverse of the order cited in paragraph 4-21*d*.

4-25. Bench Testing

a. Main Sub-Assembly.

(1) Test reassembly correctness by spinning gears and determining that parts mesh freely and smoothly, without unusual operating noises.

(2) Attach air line to bearing cover (67) port and test piston-clutch plate engagement under 100 to 300 psi.

(3) Install sub-assembly on transmission mounting (para 2-41). Through small sub-assembly flange opening, measure backlash at idler gear (51). If backlash exceeds tolerances of 0.006 to 0.020 inch, vary gasket (3) thickness combinations until prescribed tolerance limits are reached.

b. Small Sub-Assembly.

(1) Test reassembly correctness (para 4-25*a* (1)).

(2) Install sub-assembly on main sub-assembly (para 2-41). Remove cover plate (20) and measure backlash at input gear (27). If backlash

exceeds tolerances of 0.006 to 0.012 inch, vary gasket (17) thickness combinations until prescribed tolerance limits are reached.

(3) Pre-load cone bearings by inserting combinations of gaskets (7, 35) that will permit shaft (37) to roll freely without noticeable end play.

c. Testing of Gears. Test all gears for proper backlash with mating gears. Successively check backlash between each pair of mating gears, by immobilizing first one mating gear, then the other; then rotate the free gear back and forth, measuring the travel distance with a dial indicator. If travel distance exceeds 0.006-to 0.010-inch permissible tolerances (para 4-25 *a* and *b* for exceptions) determine the cause. If the cause of incorrect backlash is worn or damaged gears, replace as needed. If out-of-round or otherwise defective shafts are the cause, replace shafts. Inspect shaft bearing components for wear or damage; if neither of the first two causes of incorrect backlash apply, replace faulty components.

4-26. Installation

Discard cork shipping gasket supplied with transmission and install PTO assembly (para 2-41).

Section III. TRANSMISSION ON-VEHICLE PRESSURE TESTS

4-27. Pressure

a. General. Test the transmission/torque converter for correct operating pressures if a malfunction is suspected. Figure 4-6 shows fluid ports at the transmission and indicates correct operating pressures. Connect suitable oil pressure gages to the ports indicated or to hydraulic lines connected to them (refer to the transmission hydraulic diagram, fig 2-5). Refer to troubleshooting chart, chapter 2, to identify the cause of any malfunction.

b. Operating Pressures.

(1) When the ditcher is driven in normal road-travel operation, main oil pressure should go from near stall pressure to approximately maximum vehicle speed pressure from a standing start on level ground. Simultaneously, converter inlet pressure should diminish while governor (pitot) pressure increases. Lockup pressure should be low until governor (pitot) pressure stabilizes, at which point lockup pressure should approximately equal main pressure.

(2) *During Upshifts.* When the ditcher is upshifted in normal forward road travel, main oil pressure will increase slightly, then diminish to approximately maximum vehicle speed pressure. Simultaneously, governor (pitot) pressure and lockup pressure will decrease and then increase, while converter inlet pressure increases and then decreases.

(3) *During Downshifts.* The downshift inhibitor in the transmission control console prevents downshifting except when engine speed is low enough to reduce governor (pitot) and lockup pressures.

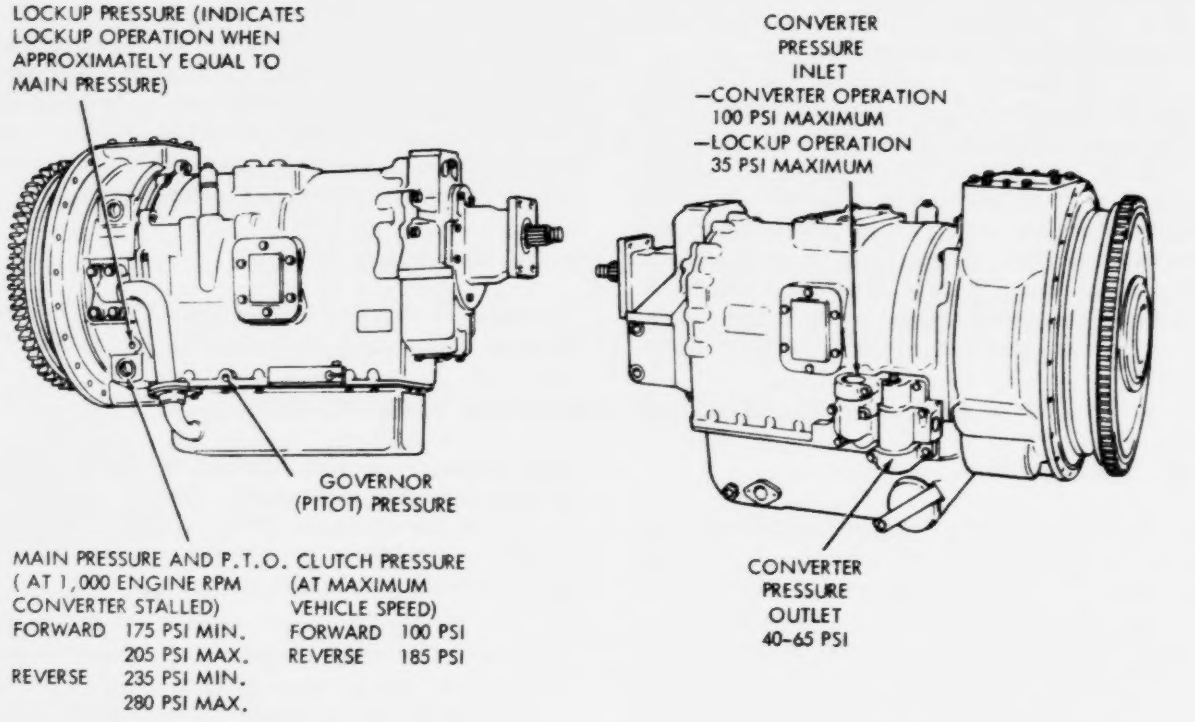
LOCKUP PRESSURE (INDICATES
LOCKUP OPERATION WHEN
APPROXIMATELY EQUAL TO
MAIN PRESSURE)
CONVERTER
PRESSURE
INLET
–CONVERTER OPERATION
100 PSI MAXIMUM
–LOCKUP OPERATION
35 PSI MAXIMUM
GOVERNOR
(PITOT) PRESSURE
MAIN PRESSURE AND P.T.O.
(AT 1,000 ENGINE RPM
CONVERTER STALLED)
FORWARD 175 PSI MIN.
205 PSI MAX.
REVERSE 235 PSI MIN.
280 PSI MAX.
CLUTCH PRESSURE
(AT MAXIMUM
VEHICLE SPEED)
FORWARD 100 PSI
REVERSE 185 PSI
CONVERTER
PRESSURE
OUTLET
40-65 PSI

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Figure 4-6. Transmission/torque converter oil pressure check points.

Section IV. TRANSMISSION/TORQUE CONVERTER REMOVAL AND DISASSEMBLY INTO SUBASSEMBLIES

4-28. Removal

Refer to paragraph 2-41 and remove the transmission assembly from the ditcher.

4-29. Preparation for Disassembly

a. Arrangement of Disassembly Procedures.

(1) The disassembly procedures in this section describe the disassembly of the transmission into sub-assemblies. Rebuild of the sub-assemblies is described in section VI.

(2) Refer to the cross-section drawing, figure 4-1, for functional location of parts. Refer to figure 4-3 and other exploded views for parts identification.

b. Preparation for Disassembly.

(1) Drain the transmission if it was not drained before removal from the ditcher. See figure 4-7.

(2) Refer to paragraph 2-2, specially designed tools, before beginning disassembly.

4-30. Transmission/Torque Converter Disassembly

a. Removal of Minor Assemblies.

(1) Using a 2 3/4 inch socket, remove the output flange retaining nut (1, fig. 4-8). To block the flange from rotating, install two bolts into the output flange to hold a heavy bar for leverage.

(2) Using a special puller (fig. 4-9), remove the output flange.

(3) Attach a lifting sling to the top of the transmission rear cover and raise the transmission. Lower the transmission onto wooden blocks, resting it upon the torque converter housing (fig. 4-10).

(4) Remove the nut (8, fig. 4-11) and bolt (9) holding the oil screen cover strap (10). Remove the strap.

(5) Remove the oil screen cover assembly (11), spring (12), seal ring (13) and screen (14).

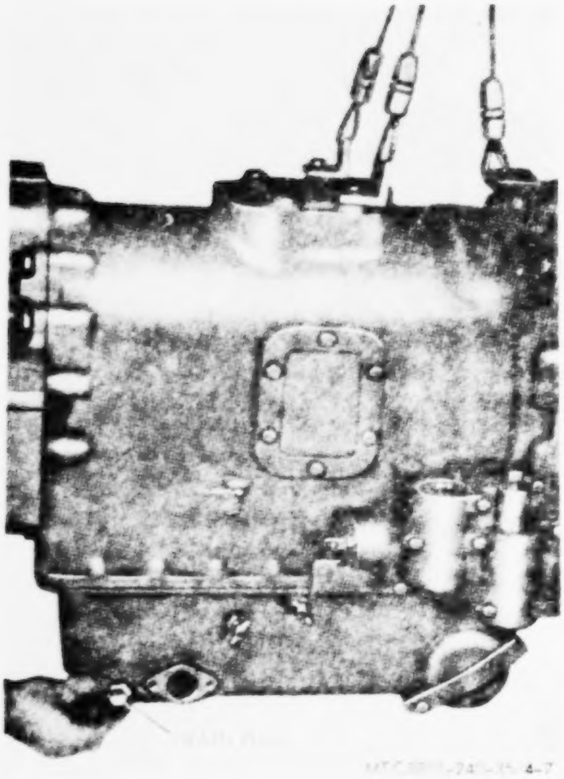


Figure 4-7. Oil drain plug removal.

(6) Remove five long bolts (1, fig. 4–12), two medium length bolts (3) and one short bolt (5) and lock washers (2, 4, 6) from the adaptor assembly (7). Remove the assembly and gasket (8).

(7) Remove four bolts (11, fig. 4–13) and lock washers (12) from the suction tube flange. Remove two bolts (5, fig. 4–11) and nuts (4) from the oil suction tube flange and remove the tube and gasket with the flange (6). Remove the packing (7) and flange (6) from the tube.

b. Removal of Oil Pan, Valve Assemblies and Oil Transfer Plate.

(1) Remove 29 self-locking bolts (1, fig. 4–11) from the oil pan.

(2) Remove the oil pan (2) and gasket (3).

(3) Remove 15 long (1, fig. 4–14) and one short (2) bolts (with lock washers (3)) from the valve body cover (12). See figure 4–15. Do not remove the five 1/4–20 x 1 bolts (marked A, fig. 4–15) that retain the valve cover (12) to the valve body. Remove the valve housing (4).

(4) Remove the six long bolts (11, fig. 4–12) and lockwashers (12) holding the converter pressure regulator and remove the regulator. Remove ten long (7, fig. 4–14) and ten short (5) bolts with lockwashers (6 and 8), holding the oil transfer plate, and remove the plate (9).

c. Removal of Rear Cover.

(1) Remove the two bolts (10, fig. 4–8) and lockwashers (11) that retain the speedometer cover. Remove the cover (12), and bearing (14).

(2) Remove seven short bolts (3), one long bolt (5) and eight lock washers (4 and 6) that retain the rear bearing retainer (7).

(3) Remove the rear bearing retainer assembly (7) and gasket (15). If necessary, use jackscrews to loosen the bearing retainer.

(4) Using a bearing puller, remove the rear bearing (16). Remove the larger spacer (17) and speedometer drive gear (18). Remove the inner spacer (19).

(5) Remove the output shaft snap ring (20) and reverse planetary carrier snap ring (21).

(6) Loosen the nut (18, fig. 4–16) and bolt (20) which clamps the outside lever (21) onto the manual selector shaft assembly. Remove the outside lever (21), snap ring (22), and seal ring (24). Remove the shaft assembly (23).

(7) Remove three clutch reaction housing nuts (33, 36, and 39), and washers (34 37, and 40), and two bolts (44 and 47), lock washers (45 and 48), and flat washers (46 and 49) from piston housings. Remove the fifteen short bolts (26, fig. 4–8), one long bolt (24), and lock washers (25 and 27) retaining the transmission rear cover (28).

(8) Remove as a unit, the cover (28), reverse-range carrier assembly (1 through 7, fig. 4–17) and bearing (22, fig. 4–8). Remove the gasket (29). See figure 4–18.

(9) Remove the carrier (7, fig. 4–17) from the bearing (22, fig. 4–8) and rear cover (28) by pressing or tapping with a soft hammer toward the front of the cover. Press or tap the bearing from the cover.

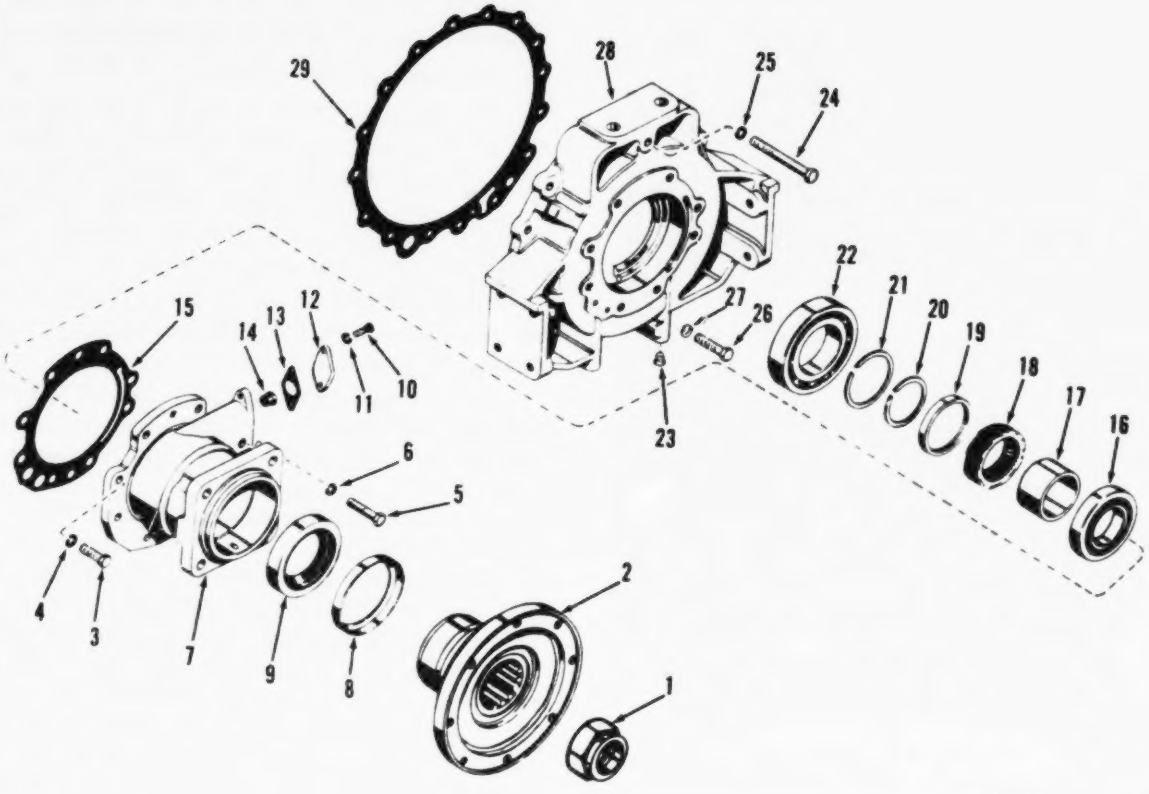
d. Removal of Output Shaft, Reverse-Range Gearing and Clutch.

(1) Remove the transmission output shaft (10, fig. 4–17). Remove the spacer (9) from the shaft.

(2) Remove the reverse-range ring gear (1, fig. 4–19), and internal-splined clutch plate (3) and reaction housing (2).

(3) Remove remaining internal-splined (3) and external-tanged (4) clutch plates and the clutch apply plate (5). Remove the reverse-range anchor bolt (41, fig. 4–16).

(4) Remove the reverse-range piston return spring (6, fig. 4–19).



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1 Nut, self-lkg, hex
2 Flange, rear
3 Bolt, machine, 1/2-13 x 1/18 (7 rqr)
4 Washer, lock, 1/2-in. (7 rqr)
5 Bolt, machine, 1/2–13 x 2 3/4
6 Washer, lock, 1/2-in.
7 Retainer
8 Baffle
9 Seal, plain, encased
10 Bolt, machine, 5–16–24 x 7/8 (2 rqr)
11 Washer, lock, 5/16-in. (2 rqr)
12 Cover, speedo, outlet
13 Gasket
14 Bearing, sleeve
15 Gasket
16 Bearing, ball
17 Spacer, ring
18 Gear, worm
19 Spacer, ring
20 Ring, retaining
21 Ring, retaining
22 Bearing, ball
23 Plug, 1/8-in. NPT
24 Bolt, machine, 1/2–13 x 4
25 Washer, lock, 1/2-in.
26 Bolt, machine, 1/2–13 x 1 3/4 (15 rqr)
27 Washer, lock, 1/2-in. (15 rqr)
28 Cover, transmission, rear
29 Gasket, rear

Figure 4-8. Transmission rear cover and output flange assemblies, exploded view.

(5) Remove the reverse-range clutch piston (7). If necessary, use compressed air in the piston apply hole to loosen the piston. Remove the seal ring (8) from the outside diameter of the piston (fig. 4-20).

e. Removal of Low-range Gearing and Clutch.

(1) Attach a lifting sling to the low- and reverse-range piston housing (9, fig. 4-19) and raise the housing. Remove the seal ring (12) from the outside diameter of the piston housing hub (fig. 4-21).

***Caution.* Support the low-range piston (11, fig. 4-19) as the piston housing (9) is raised to prevent the piston from falling out.**

(2) Remove the low-range piston (11) from the piston housing (9). Remove the seal rings (10 and 13) from the outside diameter of the piston and from the housing hub.

(3) Remove the low-range piston return spring (14) and the reverse-range sun gear thrust washer (21, fig. 4-22).

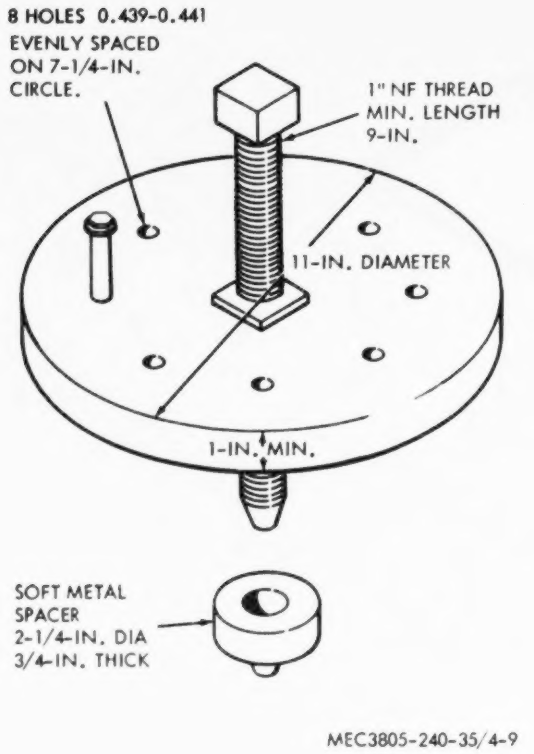


Figure 4-9. Special puller tool for removing output flange.

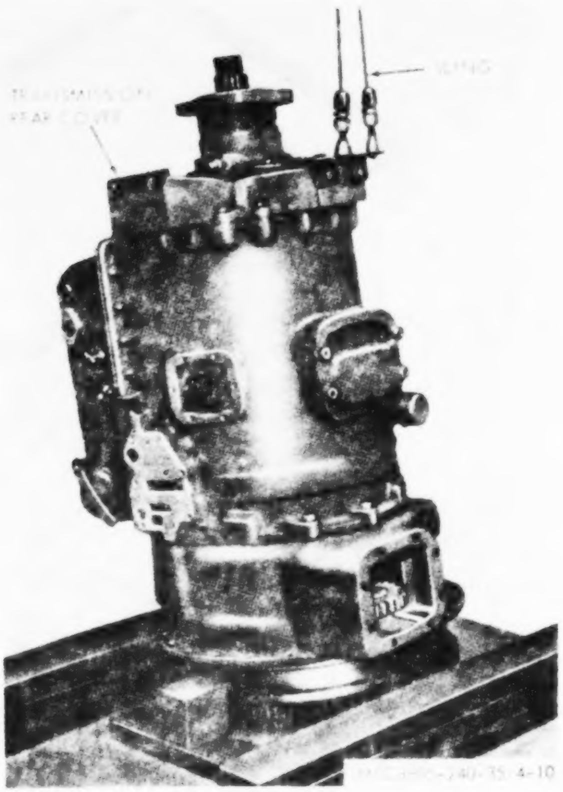


Figure 4-10. Transmission positioned with output shaft up.

(4) Remove the reverse-range sun gear snap ring (20). Remove the sun gear (22).

(5) Using a heavy wire, hook the bottom of the low-range carrier (19) and lift up to remove the assembly. Remove the thrust washer (23) from the hub end. See figure 4-23.

(6) Using snap ring pliers, remove the low-range sun gear snap ring (1, fig. 4-22) from the splitter output shaft. Remove sun gear (2).

f. Removal of Intermediate-range Gearing and Clutch.

(1) Remove the intermediate-range sun gear (4, fig. 4-22) and bearing (3) from the splitter output shaft. Remove the low-range clutch apply plate (15, fig. 4-19).

(2) Remove two internal-spline (16) and one external-tanged (17), low-range clutch plates. As a unit, remove the low-range ring gear (24, fig. 4-22) and intermediate-range carrier (12) with pinions, as an assembly. Remove snap ring (5) holding the gear and carrier together. Separate the ring gear and carrier and assembly.

(3) Remove the low-range reaction housing anchor bolt (38, fig. 4-16). Remove the reaction housing (18, fig. 4-19).

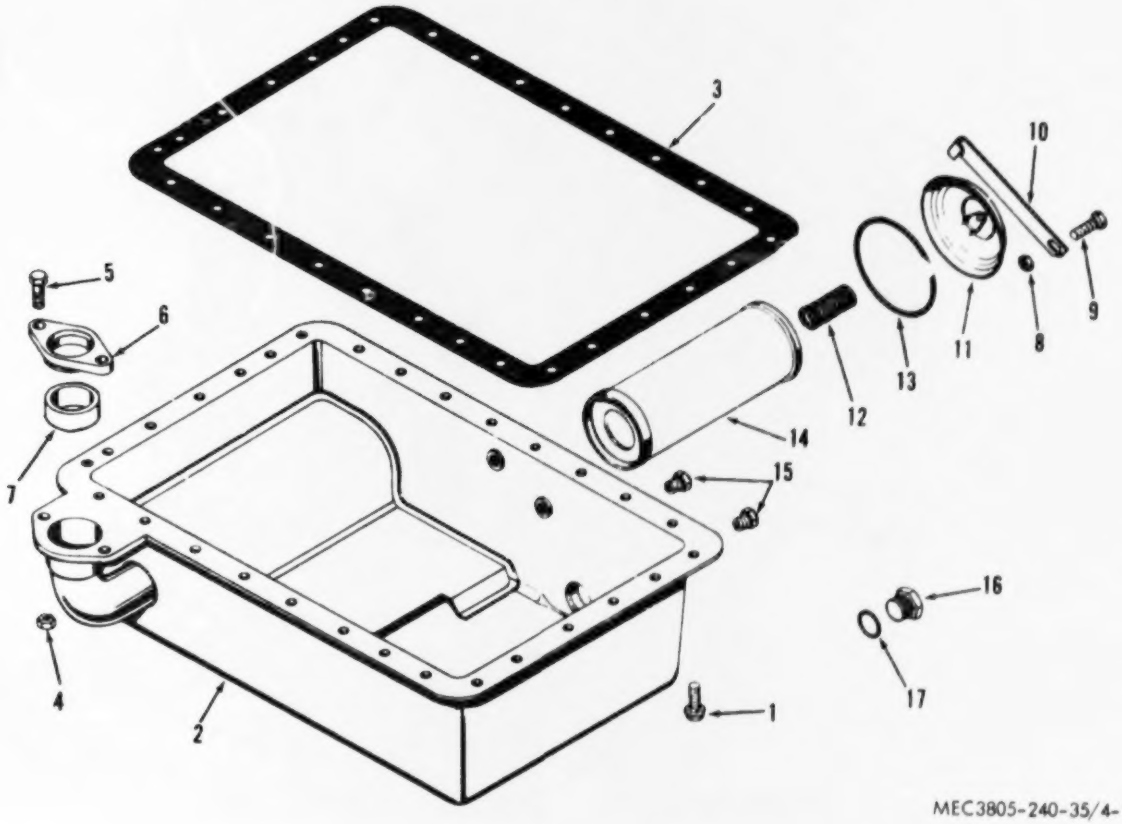
(4) Remove the intermediate-range piston housing (5, fig. 4-24) and piston (6), and piston return spring (7).

(5) Remove, as a unit, the intermediate-range clutch apply plate (1), two internal-splined clutch plates (2), one external-tanged clutch plate (3) and the intermediate-range ring gear (8).

(6) Remove the remaining external-tanged (3) and internal-splined (2), intermediate-range clutch plates.

(7) Remove intermediate-range clutch reaction housing anchor bolt (35, fig. 4-16). Remove clutch reaction housing (4) and oil baffle (11).

(8) Install the intermediate-range sun gear (4, fig. 4-22) and the low-range sun gear (2) onto the splitter output shaft. Secure the sun gears with the snap ring (fig. 4-25). The purpose of this procedure is to hold the clutch pack together so that the front pitot tube will not be damaged



1 Bolt, self-locking, 5/16-18 x 7/8 (29 rqr)
2 Oil pan
3 Gasket
4 Nut, plain, hex, 3/8-24 (2 rqr)
5 Bolt, machine, 3/8-24 x 1
6 Flange
7 Packing preformed
8 Nut, plain, hex, 5/16-24
9 Bolt, machine, 5/16-24 x 1
10 Strap, retaining
11 Cover
12 Spring, helical, compression
13 Ring, seal
14 Screen, oil
15 Plug, oil level check
16 Plug, oil drain
17 Gasket, oil drain plug

Figure 4-11. Transmission oil pan assembly, exploded view.

when the transmission is positioned with the other end up.

(9) Attach two strands of the lifting sling to the two front holes on the top PTO pad on the main housing. Raise the transmission and lower it to a horizontal position on blocks. See figure 4-26.

***Caution:* Do not rest it on the flywheel at any time.**

(10) Remove the lifting sling and attach it to the front of the converter housing as shown (fig. 4-27). Raise the transmission and lower the rear end onto wooden blocks.

g. Removal of Flywheel and Lockup Clutch.

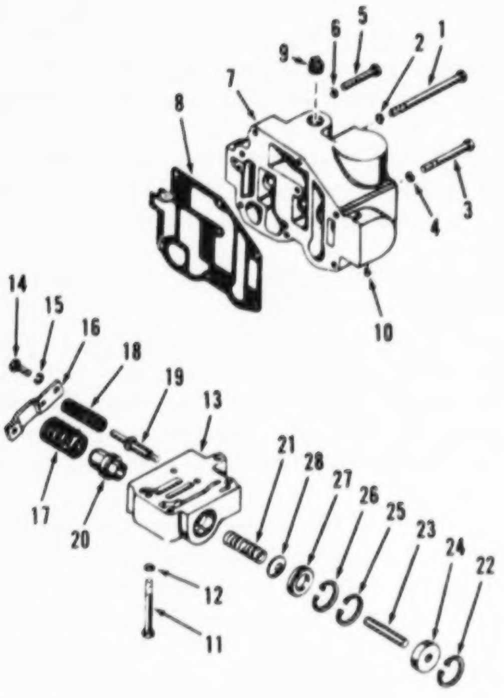
(1) Through the engine-driven PTO opening, remove 30 self-locking bolts (1, fig. 4-28) and plain washers (2) that retain the converter pump (22) to the flywheel. Block the converter pump with a wooden block to keep it from rotating. See figure 4-29.

(2) Attach a lifting sling to the flywheel and remove it and the torque converter turbine (4-30). Support the turbine so that it cannot drop off as the assembly is raised.

(3) Place the flywheel and turbine assembly on a clean table with the turbine upward. Using two large screwdrivers, carefully pry up on the turbine (3, fig. 4-28) to remove it.

(4) If necessary for parts replacement, remove bearing (4) from the hub of the turbine.

(5) Remove the lockup clutch back plate (5). Remove the lockup clutch plate (6) and the lock key (7).



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1	Bolt, machine, 5/16-18 x 4 1/2 (5 rqr)
2	Washer, lock, 5/16 -in. (5 rqr)
3	Bolt, machine, 5/16 -18 x 3 (2 rqr)
4	Washer, lock, 5/16 -in .(2 rqr)
5	Bolt, machine, 5/16-18 x 2
6	Washer, lock, 5/16 -in.
7	Adapter
8	Gasket
9	Plug, pipe
10	Plug, pipe 1/8-in. NPT
11	Bolt, machine, 1/4 -20 x 3 (6 rqr)
12	Washer, lock, 1/4 -in. (6 rqr)
13	Housing, converter and lubrication pressure regulator
14	Bolt, machine, 1/4-20 x 3/4 (3 rqr)
15	Washer, lock, 1/4 -in. (3 rqr)
16	Retainer
17	Spring, helical, compression
18	Spring, helical, compression
19	Valve
20	Valve
21	Spring, helical, compression
22	Ring, retaining
23	Pin, straight, headless
24	Washer, flat
25	Ring, retaining
26	Ring, retaining
27	Valve, seat
28	Valve, regulator

Figure 4-12. Converter pressure regulator valve assembly and adapter assembly, exploded view.

(6) Turn the flywheel over and bump it against the assembly table to remove the lockup clutch piston (8). Remove the seal ring (9 and 10) from the outside diameter of the piston and the outside diameter of the flywheel hub.

h. Removal of Converter Elements.

(1) Grasp the stator (11, fig. 4-28) and rotate it in a counterclockwise direction to lock the stator to the freewheel roller race (12). Lift up on the stator to remove it and the race (fig. 4-31).

(2) Remove the race (12) from the stator and remove the stator freewheel rollers (13) and springs (14) from the stator. Remove the thrust bearing (15) and bearing race (16) from inside the stator.

(3) Using snap ring pliers, remove the snap ring (17) from the converter ground sleeve. Remove the splined spacer (18).

(4) Flatten the corners of the lock strips (20) and remove 12 bolts (19) and six lock strips (20).

(5) Remove two bearing retainers (21). Remove the pump (22).

i. Removal of Charging Oil Pump, Oil Scavenge Pump and Converter Housing.

(1) Attach a lifting sling to the converter pump hub and raise the hub (23) and engine driven PTO drive gear (24) and bearing (25). Remove the hook-type seal ring (26) from the converter pump hub. See figure 4-32.

(2) Rotate the scavenge pump gear (10, fig. 4-33) to expose the mounting bolt heads and remove three bolts (1) and lock washers (2). See figure 4-34.

(3) Remove the scavenge pump and the engine-driven PTO idler gear retaining bolt (15, fig. 4-13), spindle (17) and gear (20).

(4) Remove 14 bolts (3 and 4) and plain washers (5) from inside the converter housing.

(5) Remove the two remaining (outside) converter housing bolts (16, fig. 4-16) and lockwashers (17). See figure 4-35. Attach the lifting sling to the converter housing (23, fig. 4-13) and raise the housing.

(6) Place the converter housing on the assembly table with the flat (front) surface down and remove two hook-type seal rings (26). Remove the thrust washer (1, fig. 4-36).

(7) Place two blocks on the splitter overdrive spring as shown in figure 4-37, and lay a heavy bar across the blocks. Use two C-clamps to compress the piston spring. Using snap ring pliers, remove the snap ring (2, fig. 4-36). Remove the piston spring (3).

(8) Remove the splitter overdrive piston (4). Remove the seal rings (5 and 6) from the piston and hub. Remove eleven self-locking bolts (7) from the piston housing and remove the housing (8). Remove four bolts (6, fig. 4-13) and lockwashers (7) from the converter ground sleeve (9). Loosen the remaining two (oppositely spaced) bolts.

(9) Tap on the two projecting bolts to loosen the input driven charging oil pump on the opposite side of the converter housing. See figure 4-38.

(10) Turn the converter housing on edge and remove the two bolts (6, fig. 4-13) and washers (7) and the input driven charging oil pump assembly. Remove the seal ring from the outside diameter of the pump. See figure 4-39.

(11) Position the converter housing on its flat surface and remove the converter ground sleeve (9, fig. 4-13). Remove the rubber-coated aluminum gasket (10).

j. Removal of Splitter Gearing and Clutches.

(1) As a unit, remove the turbine shaft (9, fig. 4-36) and splitter-direct clutch pack (19 and 20) and carrier (11) assembly from the front of the transmission housing The carrier thrust washer (1, fig. 4-40) may not come out with the shaft. If not, remove it from the transmission. Remove two of the three hook-type seal rings (10, fig. 4-36) from the turbine shaft.

(2) Remove the remaining hook-type seal ring (10) from the turbine shaft. Remove the splitter direct-drive clutch pack (11, 19 and 20) from the turbine shaft.

(3) Remove the thrust washer (12) from the turbine shaft. Remove the hook-type seal ring (13) from the end of the turbine shaft.

(4) If not removed from the transmission in (1), above, remove the large thrust washer (1, fig. 4-40) from the rear of the turbine shaft.

(5) Remove three external and three internal-tanged splitter overdrive clutch plates (14 and 15, fig. 4-36) (fig. 4-41). Remove the bolt (26, fig. 4-16) lock washer (27) and plain washer (28) that retain the splitter clutch reaction housing. Remove two diaphragm bolts (29 and 30), lock washers (32) and plain washers (31).

(6) Install two 3/8-16 bolts and a chain into the splitter reaction housing (8, fig. 4-36). Attach a suitable hoist and remove the housing (fig. 4-42).

k. Removal of Splitter Ring Gear and High-Range Clutch Assembly.

(1) Using a lifting eye in the end of the splitter output shaft, remove as a unit, the shaft, (5, fig. 4-40), the splitter ring gear (6), diaphragm (11), low-range sun gear (2, fig. 4-22) and the intermediate-range sun gear (4). See figure 4-43.

(2) Position the assembly on the assembly table with the splitter ring gear down. Remove the low-range sun gear snap ring (1, fig. 4-22).

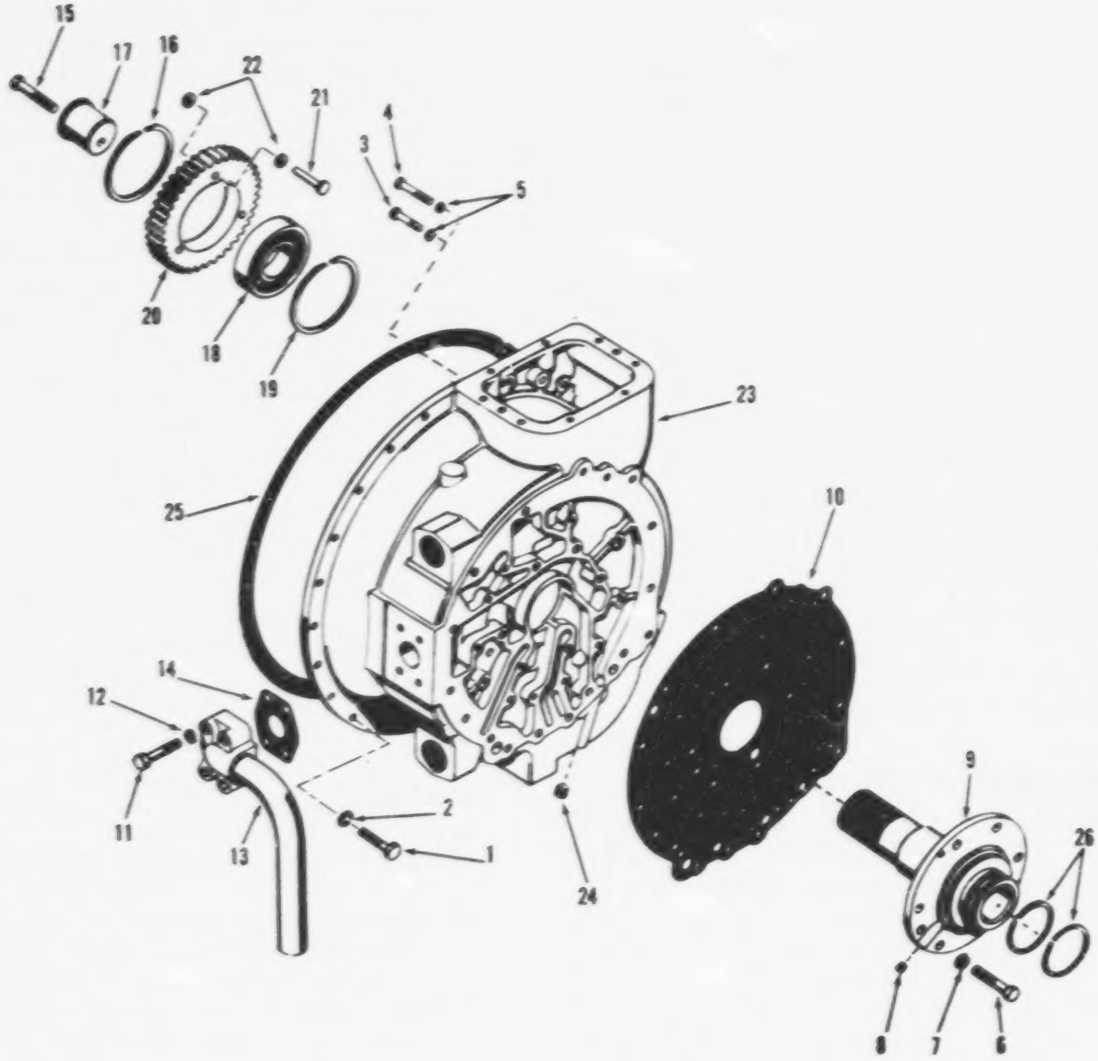
(3) Remove the low-range sun gear (2), and the intermediate-range sun gear (4) and ball bearing (3). Remove the bearing from the sun gear.

(4) Lay the assembly on its side. Holding the diaphragm and high-range clutch with one hand, remove the splitter ring gear (6, fig. 4-40) and output shaft (5) assembly with the other hand. See figure 4-44.

Caution: **Do not allow the diaphragm and high-range clutch assembly to separate or the front pitot tube will be damaged.**

(5) Position the diaphragm (11, fig. 4-40) and high-range clutch assembly on the table with the diaphragm up and remove the two pitot tube bolts and lock washers (8 and 9).

(6) Remove the diaphragm assembly (11) from the high-range clutch assembly. Remove the two hook-type seal rings (29) and thrust washer (28) from the hub. Lift out the loose pitot tube (10) from the governor oil collector ring.


15
17
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26
8
7
6

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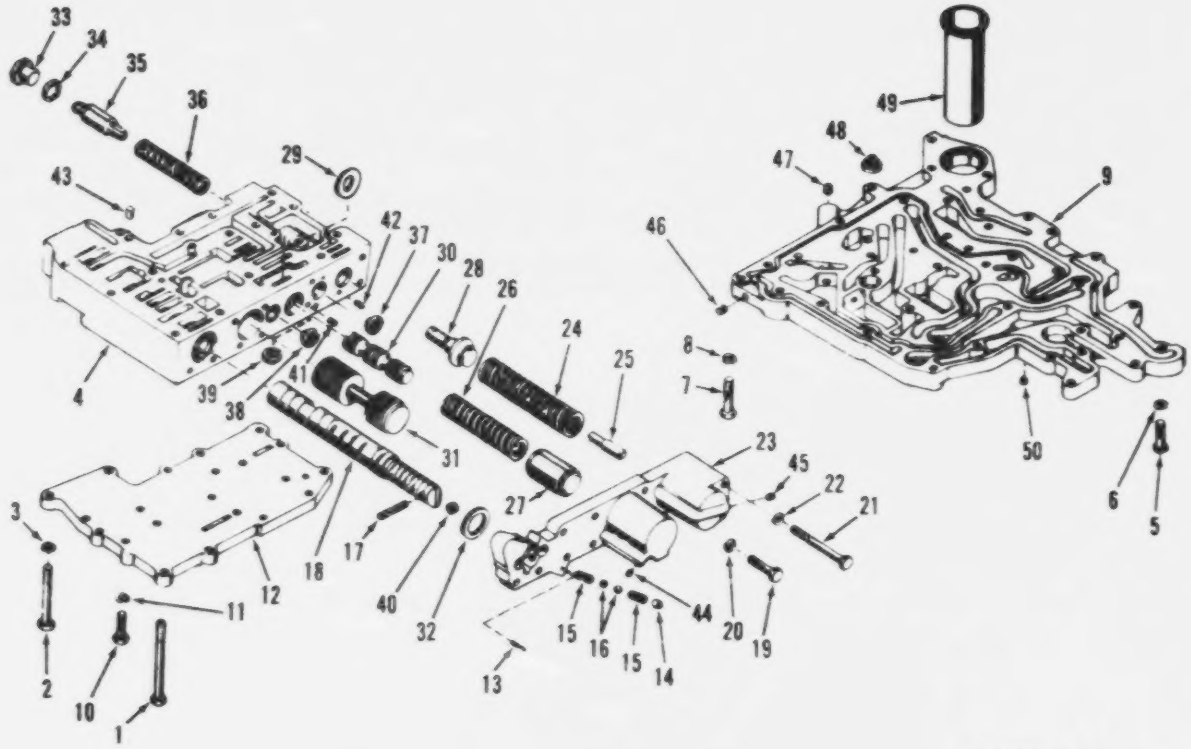
1 Bolt, machine, hex, 7/16-14 x 1 1/2 (20 rqr)
2 Washer, lock, 7/16 -in. (20 rqr)
3 Bolt, machine, hex, 1/2-13 x 1 1/4 (8 rqr)
4 Bolt, machine, hex, 1/2-18 x 4 1/2 (6 rqr)

Figure 4-13. Torque converter housing and power take-off gear assemblies, exploded view.

5 Washer, lock, 1/2 -in. (14 rqr)
6 Bolt, machine, hex, 1/2 -13 x 2 1/2 (6 rqr)
7 Washer, lock, 1/2 -in. (6 rqr)
8 Plug, 1/8 -in. NPT
9 Ground sleeve
10 Gasket, converter housing rear
11 Bolt, machine, hex, 1/2-13 x 2 1/2 (4 rqr)
12 Washer, lock, 1/2 -in. (4 rqr)
13 Tube, oil suction
14 Gasket, oil suction tube
15 Bolt, self-locking, 1/2-13 x 2 3/4
16 Ring, retaining, internal
17 Spindle, power take-off gear
18 Bearing, ball
19 Ring, retaining, internal
20 Gear, power take-off
21 Rivet (3 rqr)
22 Washer, flat (6 rqr)
23 Housing, torque converter
24 Plug
25 Gasket, torque converter housing
26 Hook-type seal ring (2 rqr)

Figure 4-15—Continued



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1	Bolt, self-locking, 1/4-20 x 3 1/2 (15 rqr)
2	Bolt, machine, 1/4-20 x 2 1/2
3	Washer, lock, 1/4 -in.
4	Housing, control valve
5	Bolt, machine, 1/4-20 x 1 (10 rqr)
6	Washer, lock, 1/4 -in. (10 rqr)
7	Bolt, machine, 1/4 -20 x 1 3/8 (10 rqr)
8	Washer, lock, 1/4 -in. (10 rqr)
9	Plate, oil transfer
10	Bolt, machine, 1/4-20 x 1 (5 rqr)
11	Washer, lock, 1/4 -in. (5 rqr)
12	Cover, valve body
13	Pin, straight, headless
14	Pin
15	Spring, helical (2 rqr)
16	Ball, bearing (2 rqr)
17	Pin, straight, headless
18	Valve
19	Bolt, machine, 1/4-20 x 1 1/3 (7 rqr)
20	Washer, lock, 1/4 -in. (7 rqr)
21	Bolt, machine, 1/4-20 x 2 1/2 (3 rqr)
22	Washer, lock, 1/4 -in. (3 rqr)
23	Cover, rear
24	Spring, helical, compression
25	Plug
26	Spring, helical, compression
27	Plug
28	Valve, pilot
29	Washer, flat
30	Valve, shift
31	Valve, flow
32	Washer, flat
33	Plug
34	Gasket, plug
35	Valve, flow
36	Spring
37	Valve, assy.
38	Valve, assy.
39	Valve, assy.
40	Bushing
41	Pin
42	Pin
43	Dowel pin
44	Setscrew—10/24 x 3/16 (2 rqr)
45	Setscrew —10/24 x 3/16
46	Plug
47	Plug
48	Valve, check
49	Tube
50	Plug

Figure 4-14. Transmission control valve assembly and oil transfer plate assembly, exploded view.

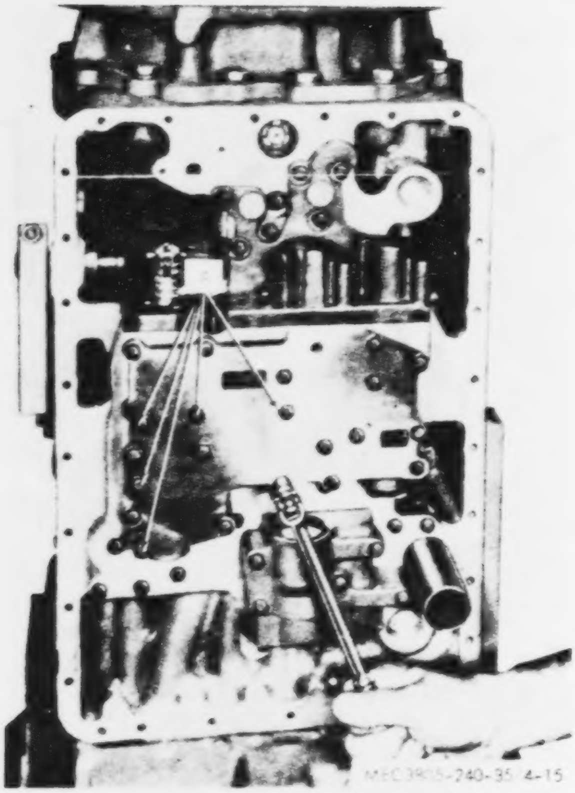
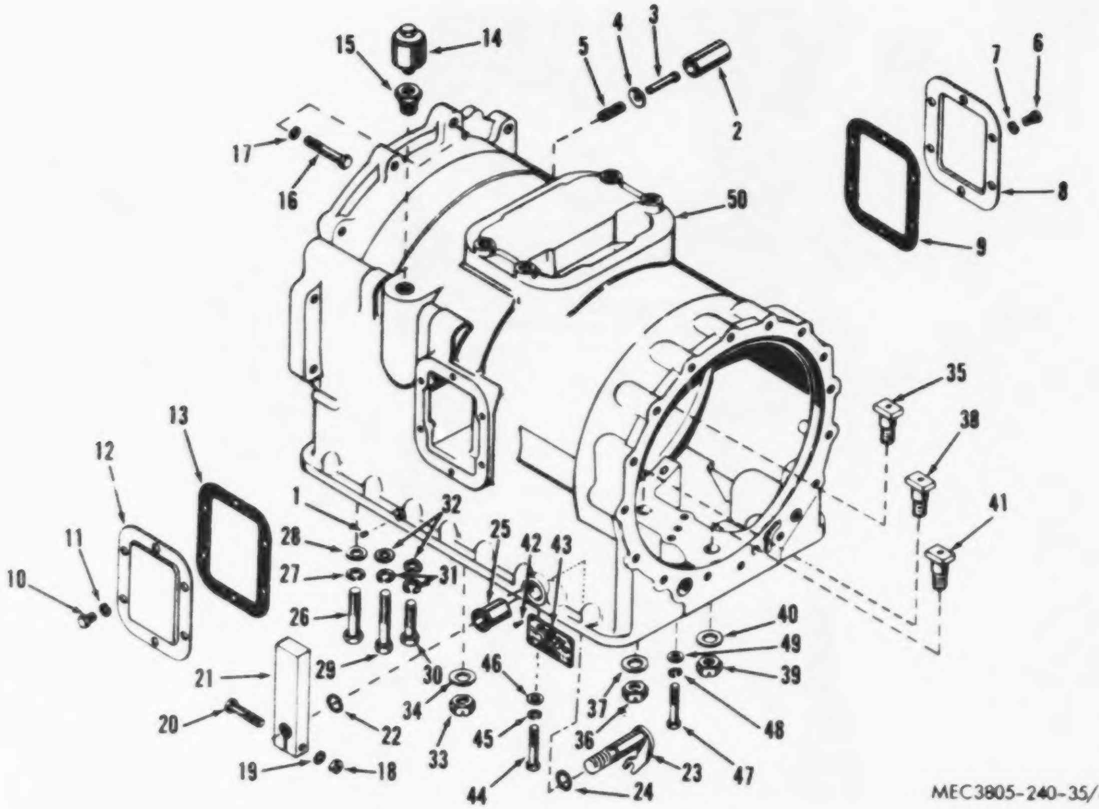

MEC 3805-240-35 4-15

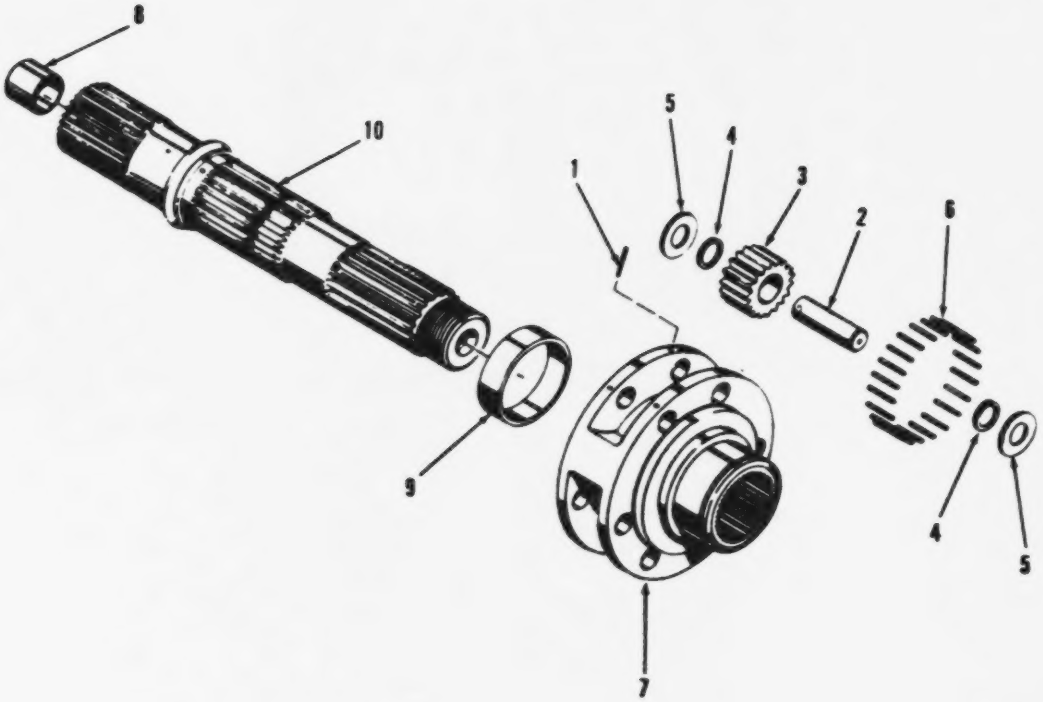
Figure 4-15. Transmission control valve mounting bolt removal.



MEC3805-240-35/4-16

1	Plug, 1/8 -in. NPT
2	Sleeve
3	Guide
4	Valve
5	Spring, valve
6	Bolt, 3/8-16 x 1 (6 rqr)
7	Washer, lock, 3/8 -in. (6 rqr)
8	Cover, P.T.O.
9	Gasket
10	Bolt, 3/8-16 x 1 (6 rqr)
11	Washer, lock, 3/8 -in. (6 rqr)
12	Cover P.T.O.
13	Gasket
14	Breather assembly
15	Bushing, 3/8 to 1/4 NPT
16	Bolt, 1/2-13 x 2 1/4 (2 rqr)
17	Washer, lock, 1/2 -in. (2 rqr)
18	Nut, 3/8-24
19	Washer, lock, 3/8-in.
20	Bolt, 3/8-24 x 2
21	Lever, manual selector
22	Ring, retaining, external
23	Manual selector shaft
24	Packing, preformed
25	Bearing, selector shaft sleeve
26	Bolt, 1/2-13 x 3 1/2
27	Washer, lock, 1/2 -in.
28	Washer, flat, 1/2 -in.
29	Bolt, 5/16-18 x 3
30	Bolt, 5/16-18 x 2 1/4
31	Washer, lock, 5/16 -in. (2 rqr)
32	Washer, flat, 5/16 -in. (2 rqr)
33	Nut, self-locking, 5/18-18
34	Washer, flat, 5/8 -in.
35	Bolt, special, intermediate range clutch anchor
36	Nut, self-locking, 5/8-18
37	Washer, flat, 5/8 -in.
38	Bolt, special, low-range clutch anchor
39	Nut, Self-locking 5/8-18
40	Washer, flat, 5/8 -in.
41	Bolt, special, reverse-range clutch anchor
42	Drive screw (4 rqr)
43	Plate, name
44	Bolt 3/8-16 x 2 1/4
45	Washer, lock, 3/8 -in.
46	Washer, flat 3/8 -in.
47	Blot, 3/8-16 x 2 1/4
48	Washer, lock, 3/8 -in.
49	Washer, flat, 3/8 -in.
50	Transmission housing

Figure 4-16. Transmission main housing assembly, exploded view.



MEC3805-240-35/4-17

1	Pin, straight, headless (6 rqr)	6	Roller, bearing (132 rqr)
2	Shaft, straight (6 rqr)	7	Carrier, planetary
3	Pinion (6 rqr)	8	Bearing, sleeve
4	Spacer, ring (12 rqr)	9	Spacer, ring
5	Washer, thrust (12 rqr)	10	Shaft, output

Figure 4-17. Transmission reverse-range planetary and output shaft assembly, exploded view.

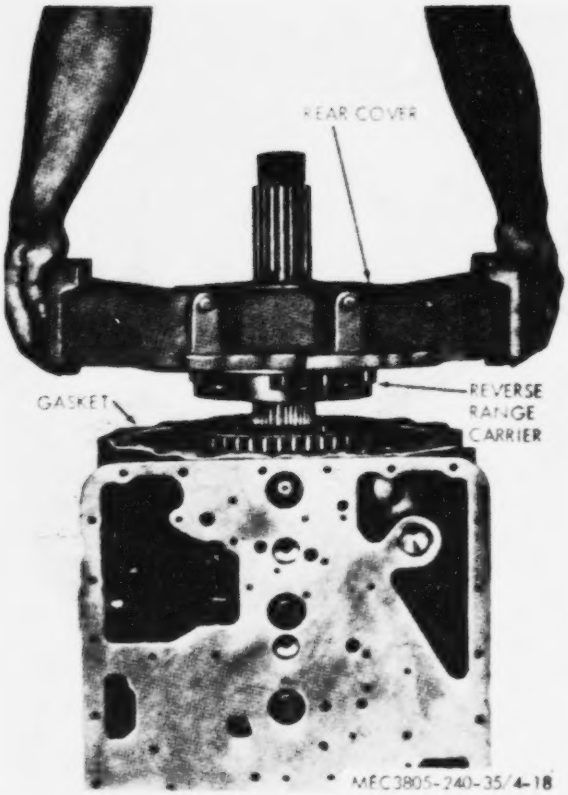
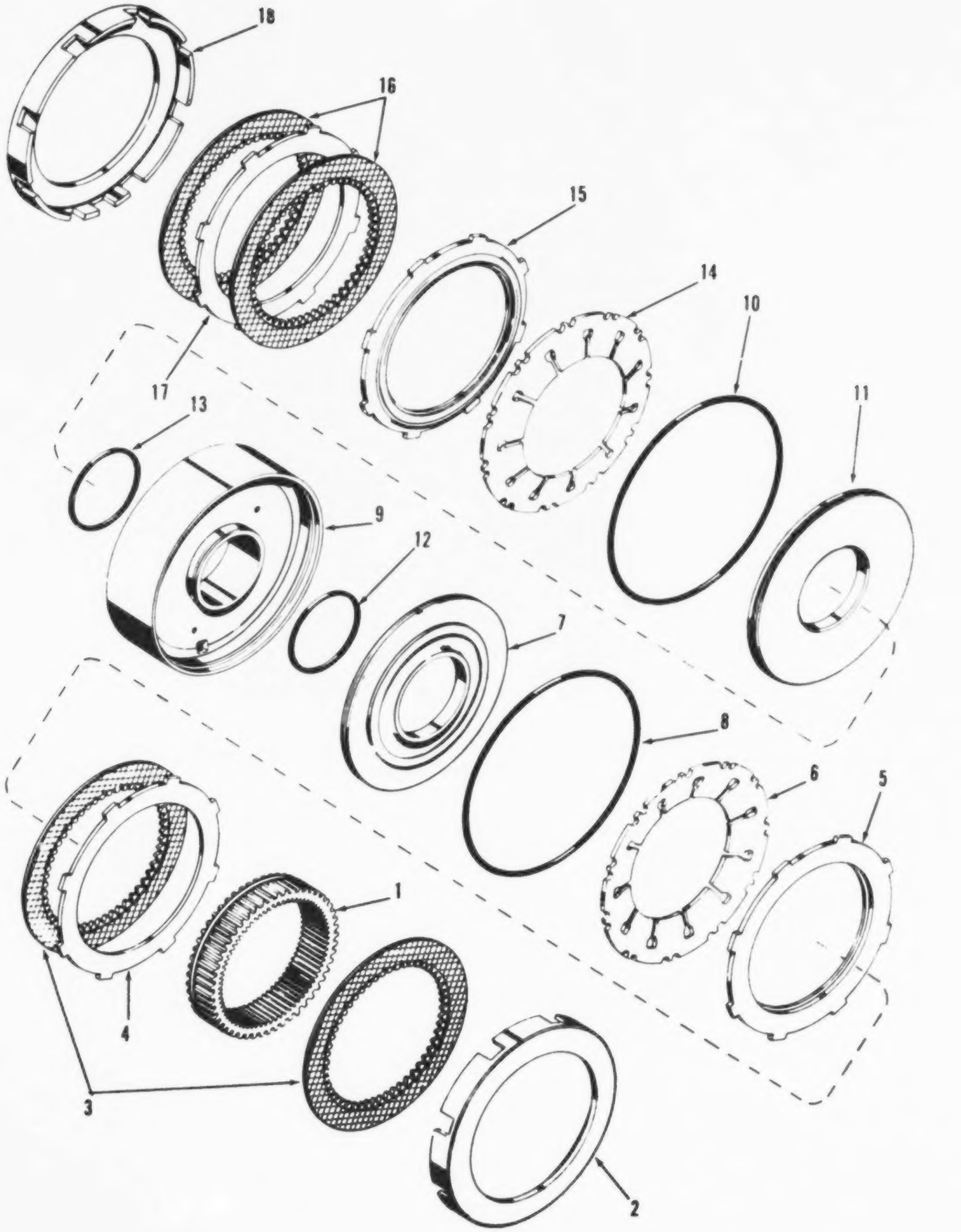

REAR COVER
GASKET
REVERSE RANGE CARRIER
MEC3805-240-35/4-18

Figure 4-18. Transmission rear cover and reverse-angle planetary removal.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MEC3805-240-35/4-19

1 Gear, reverse-range ring
2 Housing, reverse-range clutch reaction
3 Disk, clutch, internal splined (2 rqr)
4 Disk, clutch, external splined

Figure 4-19. Transmission low and reverse range clutch assemblies, exploded view.

5 Plate, clutch apply
6 Spring, flat
7 Piston, reverse-range clutch
8 Packing, preformed
9 Housing, low-and reverse-range clutch piston
10 Packing, preformed
11 Piston, low-range clutch
12 Packing, preformed
13 Packing, preformed
14 Spring, flat
15 Plate, low range clutch apply
16 Disk, clutch (2 rqr)
17 Disk, clutch
18 Housing, low-range clutch reaction

Figure 4-19—Continued

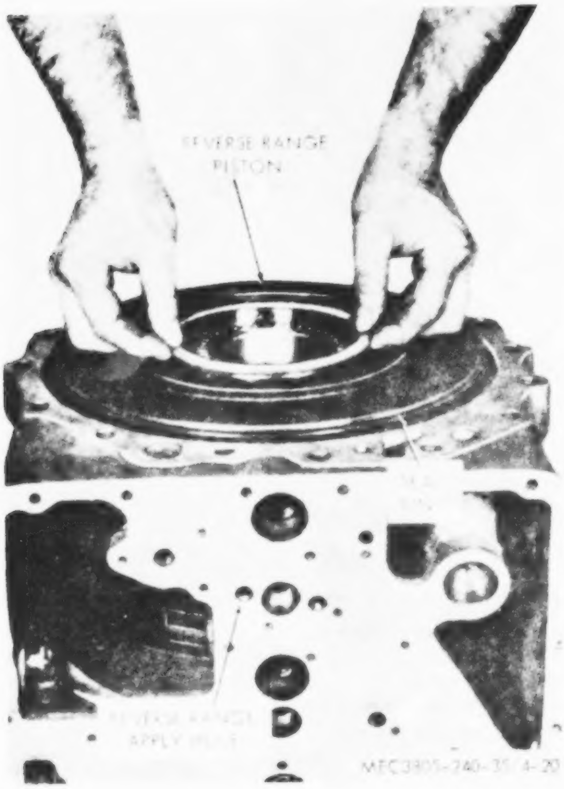

REVERSE RANGE PISTON
SEAL RING
REVERSE RANGE APPLY HOLE
MEC3805-240-35/4-20

Figure 4-20. Reverse-range clutch piston removal.

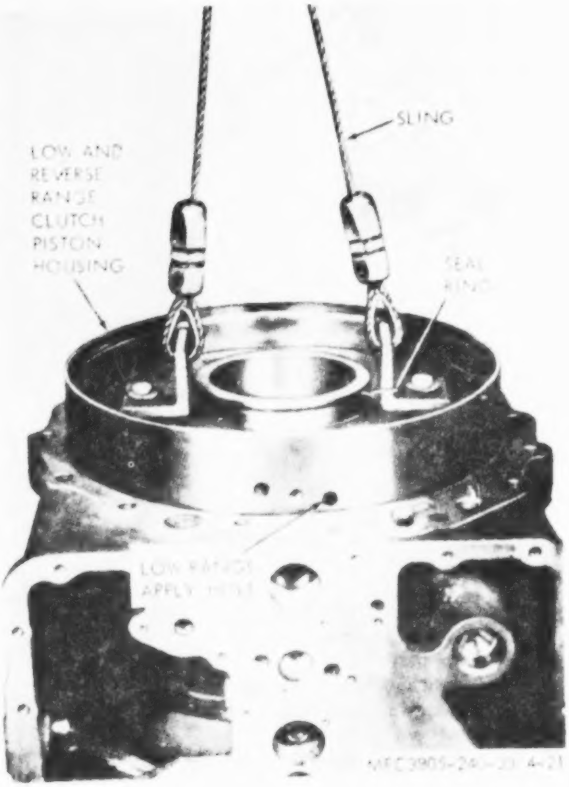
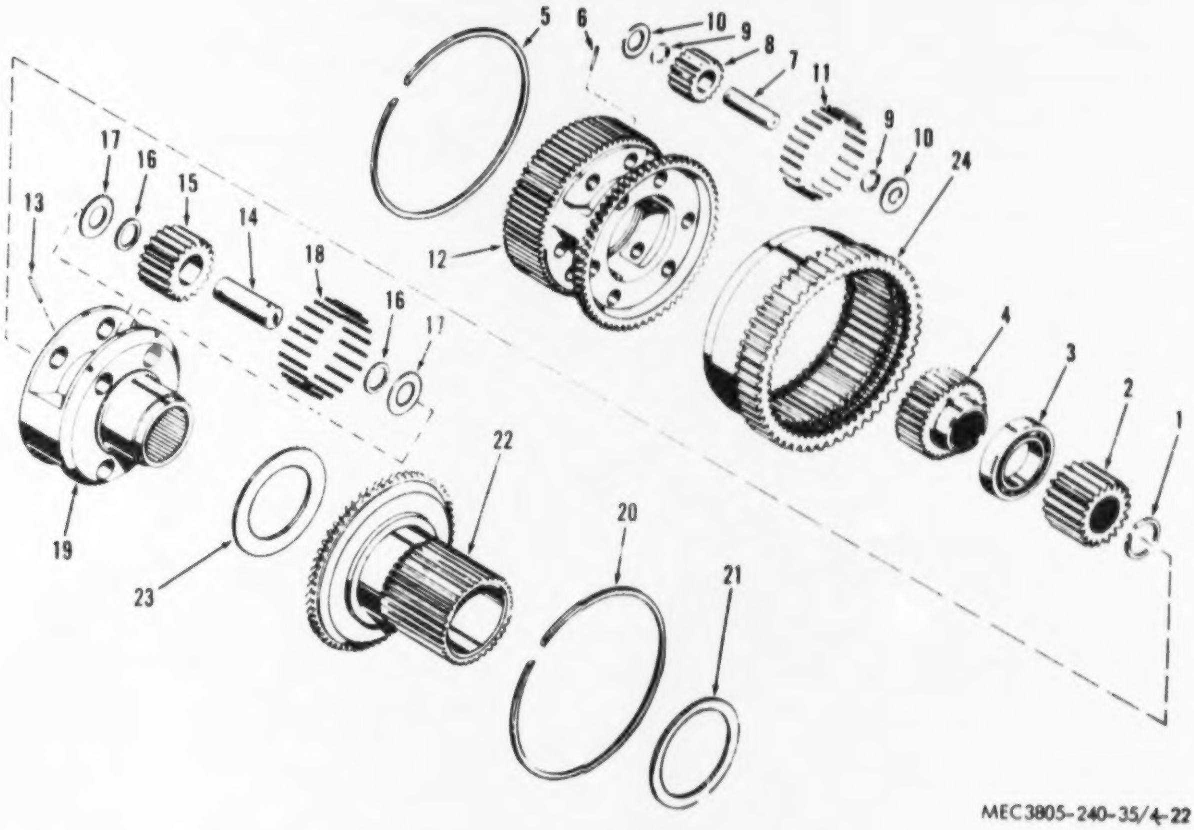

SLING
LOW AND REVERSE RANGE CLUTCH PISTON HOUSING
SEAL RING
LOW RANGE APPLY HOLE
MEC3805-240-35/4-21

Figure 4-21. Low-and reverse-range clutch piston housing removal.



MEC3805-240-35/4-22

1 Ring, retaining, external
2 Gear, low-range sun
3 Bearing, ball
4 Gear, intermediate-range sun
5 Ring, retaining, internal
6 Pin, grooved (6 rqr)
7 Spindle, pinion (6 rqr)
8 Pinion (6 rqr)
9 Spacer (12 rqr)
10 Washer, thrust (12 rqr)
11 Roller, bearing (132 rqr)
12 Carrier
13 Pin, grooved (4 rqr)
14 Spindle, pinion (4 rqr)
15 Pinion (4 rqr)
16 Spacer (8 rqr)
17 Washer, thrust (8 rqr)
18 Roller, bearing (80 rqr)
19 Carrier, low range planetary
20 Ring, retaining, internal
21 Washer, thrust
22 Gear, reverse-range sun
23 Washer, thrust
24 Gear, low-range ring

Figure 4-22. Transmission intermediate-and low-range planetary assemblies, exploded view.

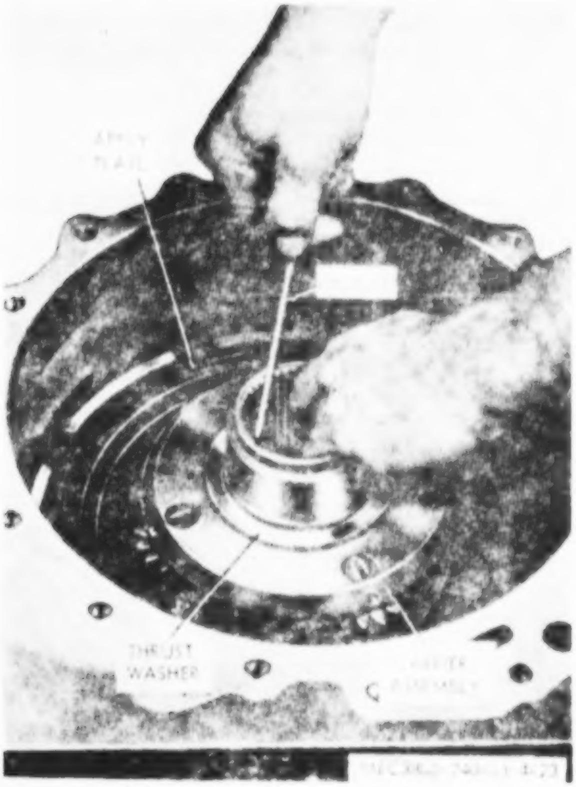
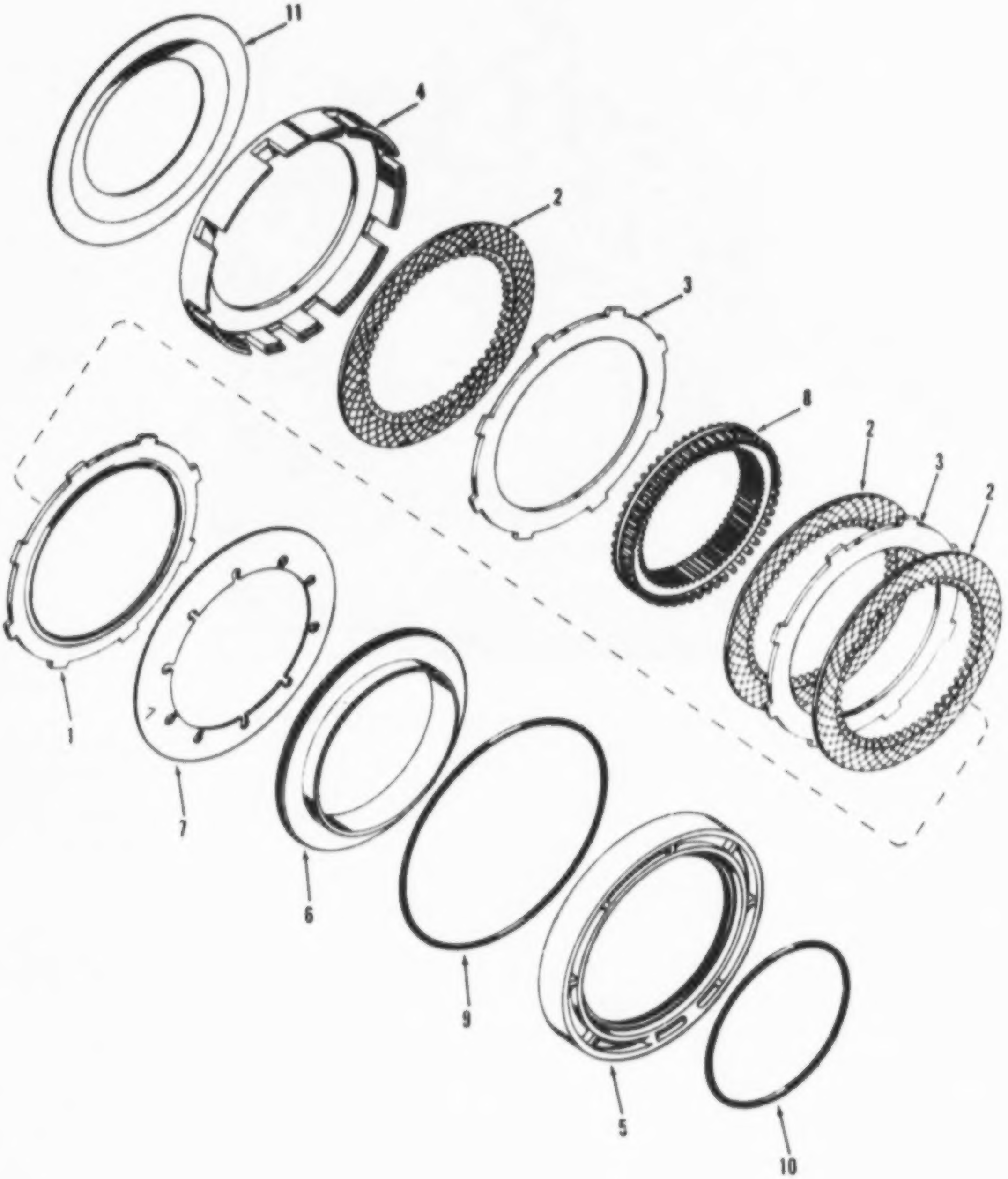

APPLY
PLATE
THRUST
WASHER
CARRIER
ASSEMBLY

Figure 4–23. Low-range carrier assembly removal.



MEC3805-240-35/4-24

1 Clutch apply plate
2 Clutch plate, intermediate-range, internal-splined (3 rqr)
3 Clutch plate, intermediate-range, external-tanged (2 rqr)
4 Intermediate-range clutch reaction housing

Figure 4-24. Transmission intermediate-range clutch assembly, exploded view.

7 Spring, clutch piston return
8 Ring gear, intermediate-range
5 Intermediate-range clutch piston housing
6 Clutch piston
9 Packing, preformed, piston outer
10 Packing, preformed, piston inner
11 Oil baffle

Figure 4-24—Continued

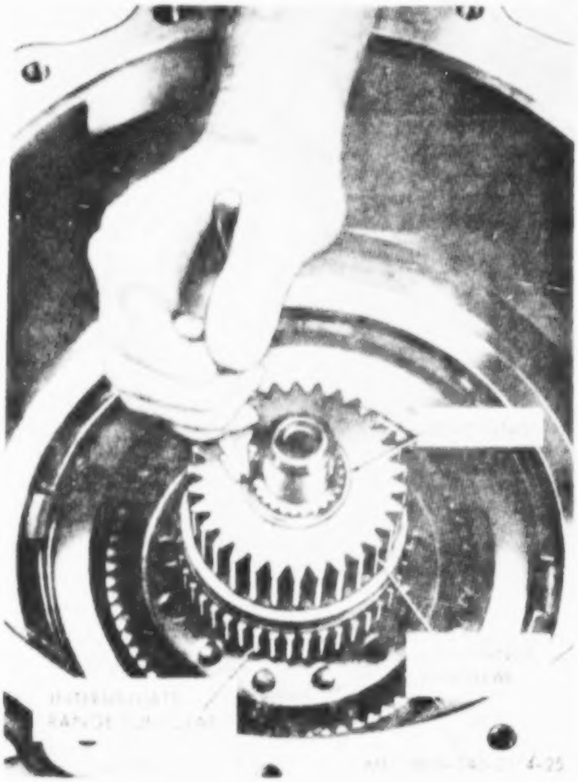


Figure 4-25. Low-range sun gear snap ring installation.

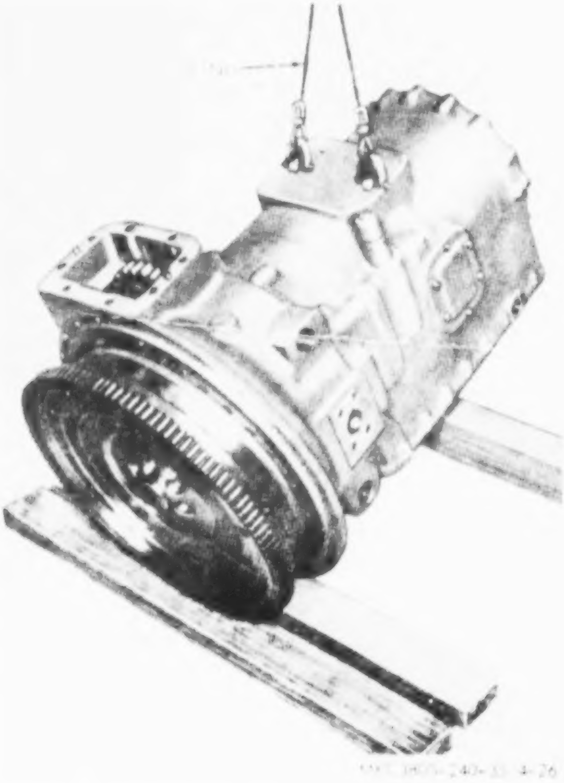
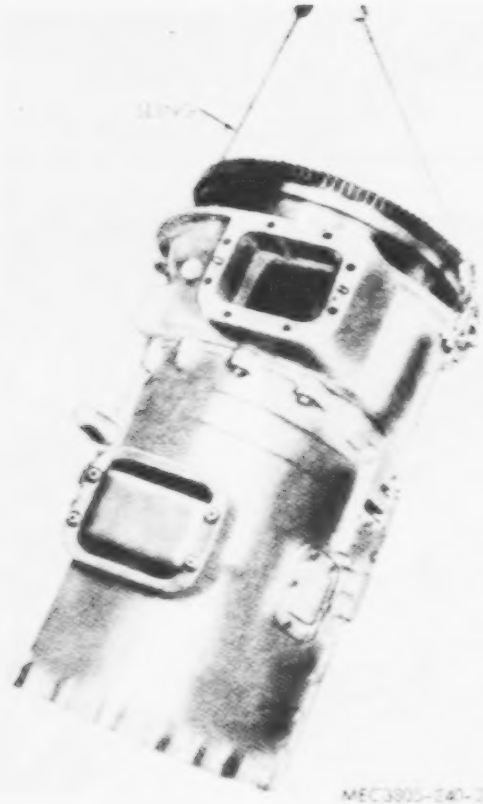
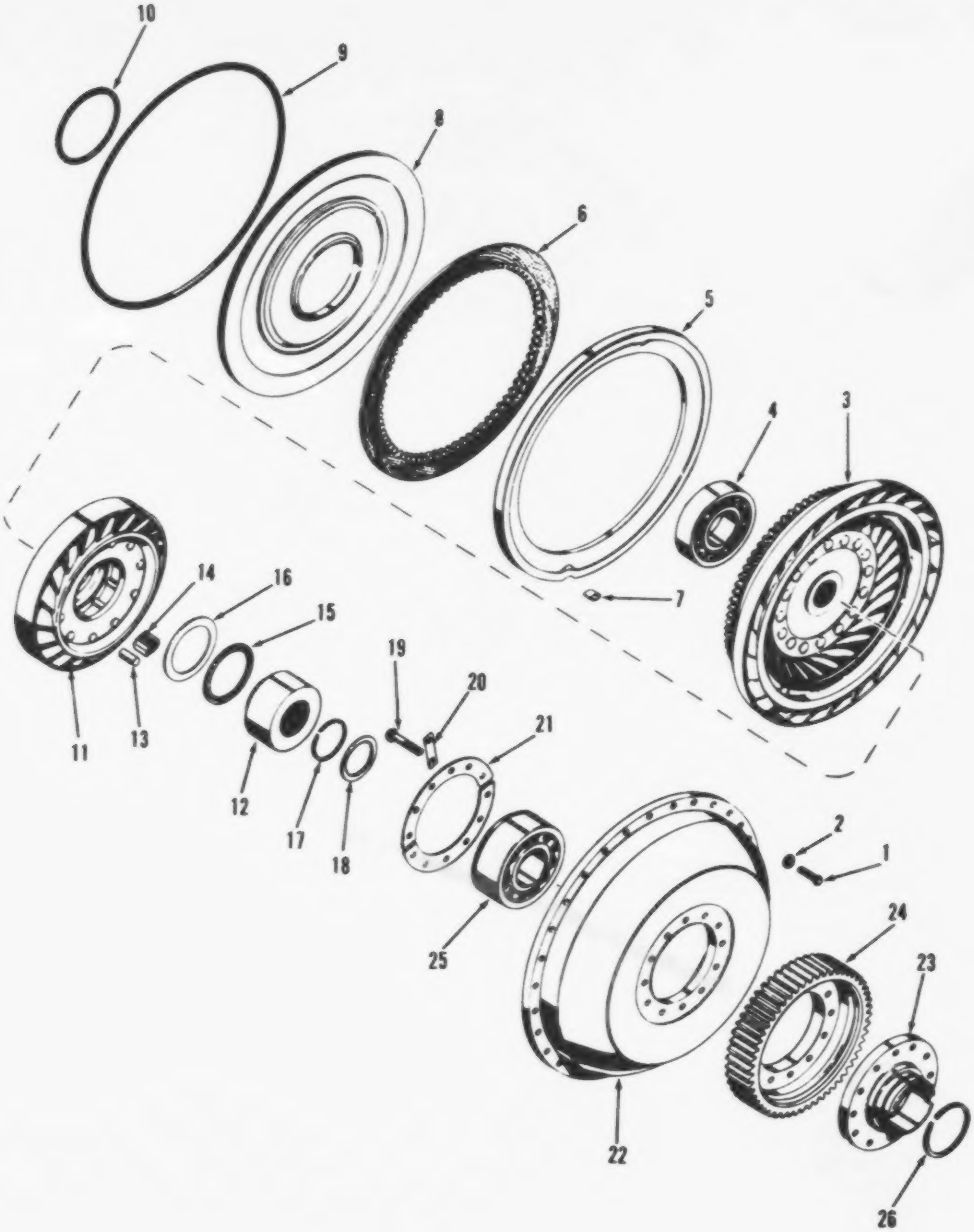


Figure 4-26. Transmission shifted to horizontal position.



MEC3805-240-35/4-27

Figure 4-27. Transmission positioned on rear end.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MEC3805-240-35/4-28

1 Bolt, self-lkg	3 Turbine
2 Washer, flat	4 Bearing, ball, annular

Figure 4-28. Torque converter and lockup clutch assemblies, exploded view.

5 Plate, lockup clutch backing
6 Plate, lockup clutch
7 Key
8 Piston, lockup clutch
9 Ring, seal, piston O.D.
10 Ring, seal, piston I.D.
11 Stator, torque convertor
12 Race, stator freewheel
13 Rollers, stator freewheel (10 rqr)
14 Spring, stator freewheel (10 rqr)
15 Bearing, thrust
16 Race, thrust bearing
17 Ring, retaining
18 Spacer, ring
19 Bolt, machine 3/8-24 x 2 1/4 (12 rqr)
20 Plate, locking (6 rqr)
21 Retainer, bearing (2 rqr)
22 Pump, torque converter
23 Hub, pump
24 Gear, spur: power take-off drive
25 Bearing, ball, annular
26 Ring, seal, metal

Figure 4-28—Continued

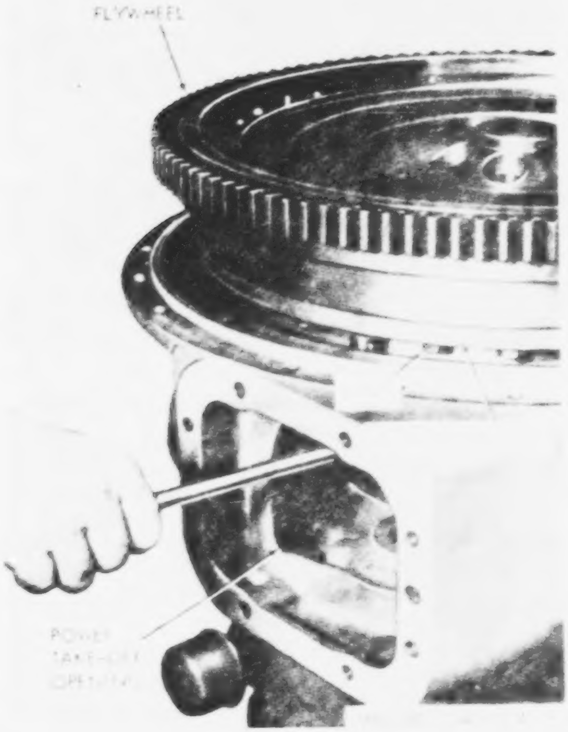


Figure 4-29. Flywheel retaining bolt removal.

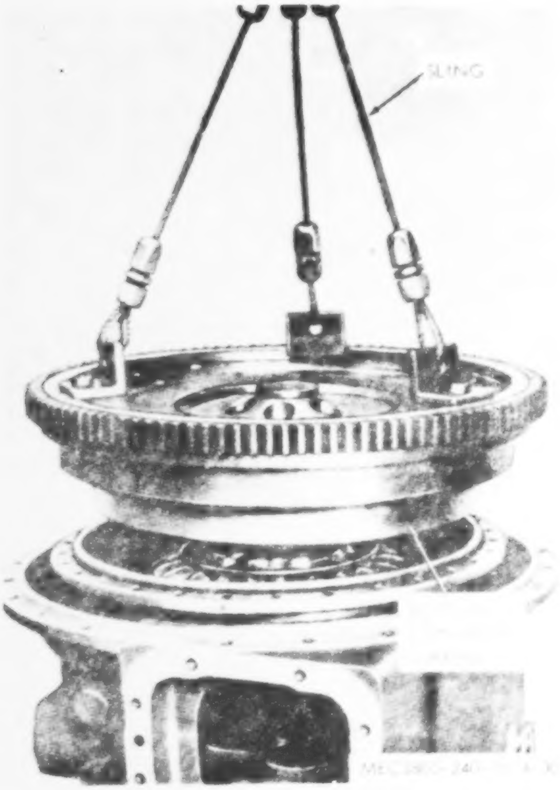


Figure 4-30. Flywheel and torque converter turbine assembly removal.

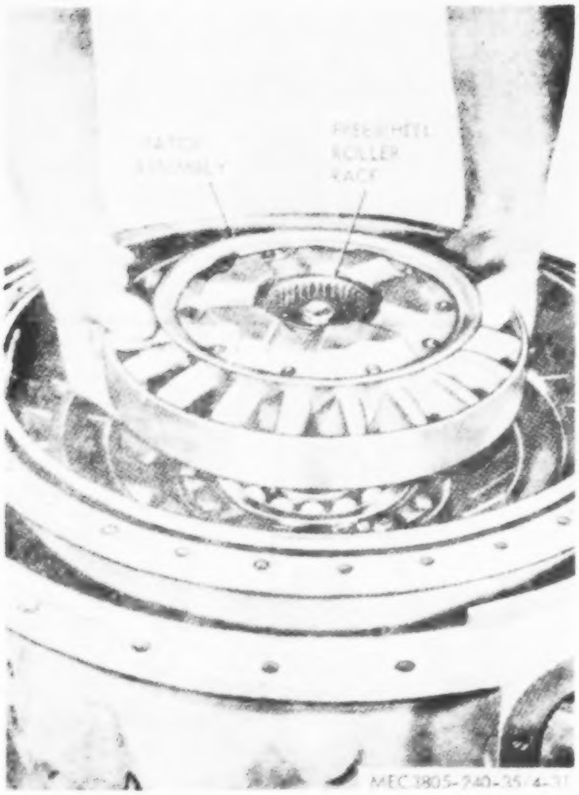

STATOR
ASSEMBLY
FREEWHEEL
ROLLER
RACE
MEC 3805-240-35/4-31

Figure 4-31. Stator assembly and roller race removal.

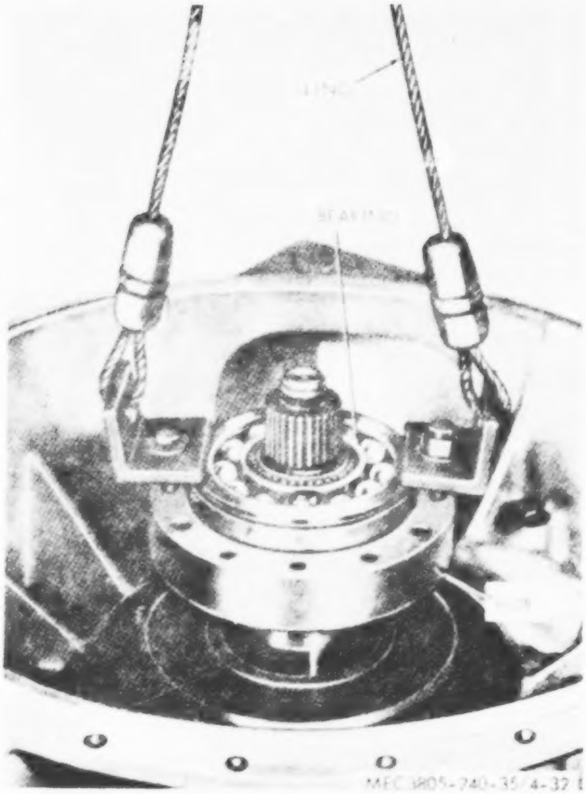
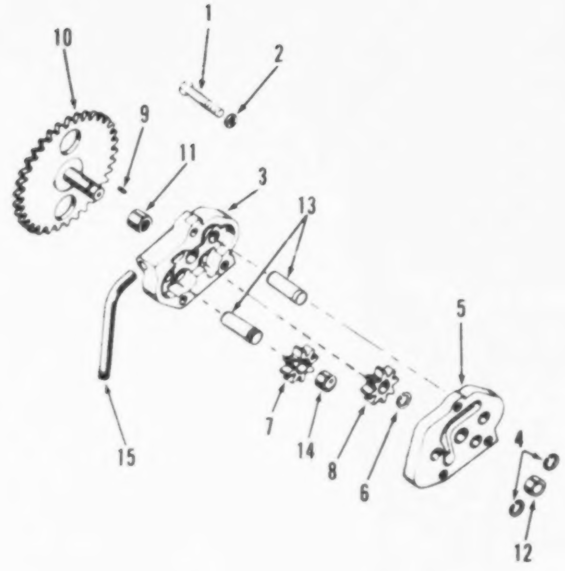

SLING
BEARING
MEC 3805-240-35/4-32

Figure 4-32. Torque converter pump hub and bearing removal.



1	Bolt, machine, 3/8-16 x 2 1/2 (3 rqr)
2	Washer, lock, 3/8 -in. (3 rqr)
3	Pump assy
4	Ring, retaining (2 rqr)
5	Plate, oil pump
6	Ring, retaining
7	Gear, spur, spindles
8	Gear, spur
9	Roller, lock
10	Gear, drive
11	Bearing, roller
12	Bearing, roller
13	Spindle (2 rqr)
14	Bearing, roller
15	Tube

Figure 4-33. Transmission/torque converter oil scavenge pump assembly, exploded view.

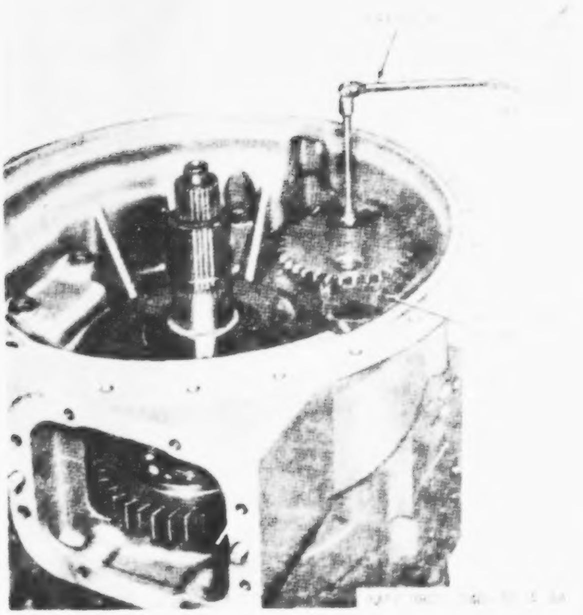
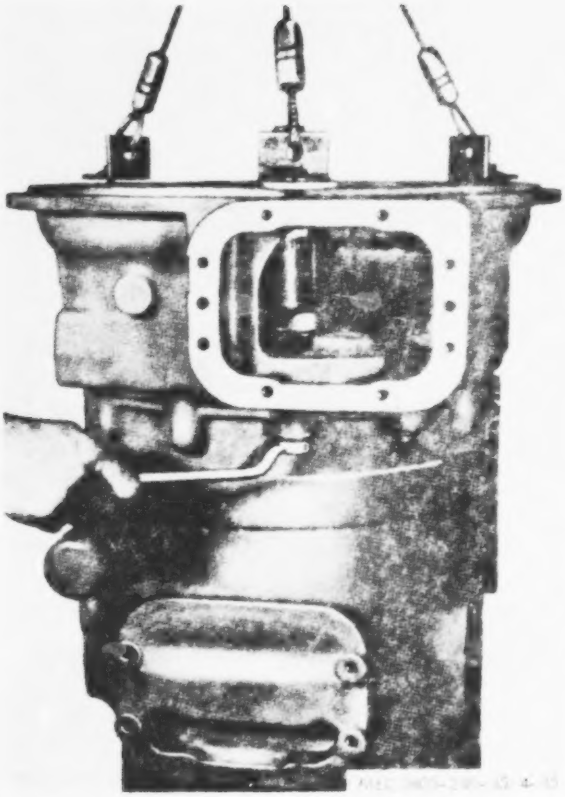
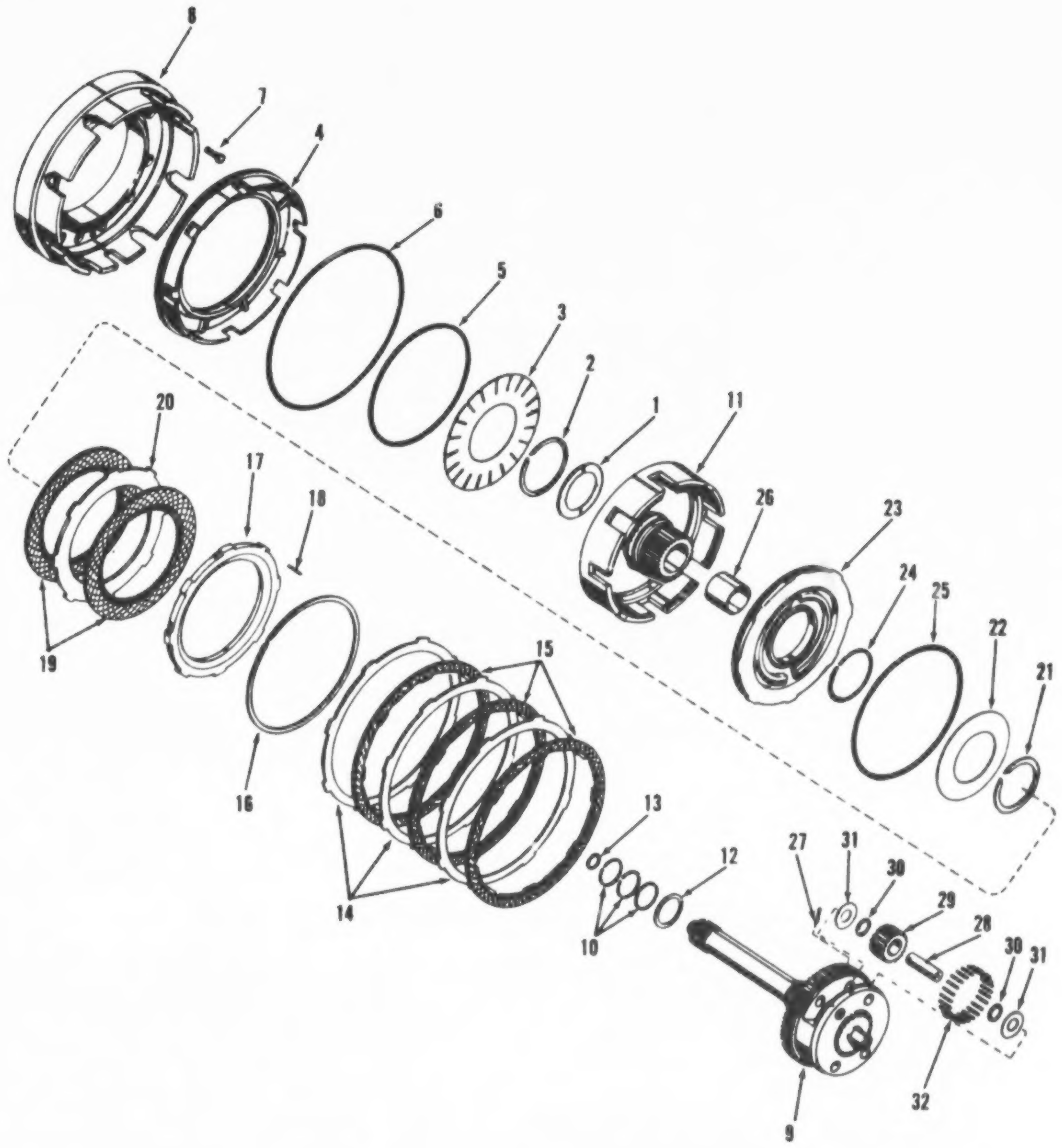


Figure 4-34. Scavenge pump bolt removal.



MEC 3805-240-35/4-35

Figure 4–35. Torque converter housing exterior bolt removal.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MEC3805-240-35/4-36

1 Washer, thrust
2 Ring, retaining, external
3 Spring, piston return
4 Piston, splitter overdrive clutch

Figure 4-36. Transmission splitter planetary and clutch assemblies, exploded view.

5 Packing, preformed, piston inner
6 Packing, preformed, piston outer
7 Bolt, self-locking, 3/8 x 1 1/8 (11 rqr)
8 Splitter overdrive clutch piston housing
9 Turbine shaft and carrier
10 Hook-type seal ring (3 rqr)
11 Splitter direct drive housing
12 Washer, thrust
13 Hook-type seal ring
14 Clutch plate, splitter over-drive external-tangled (3 rqr)
15 Clutch plate, splitter over-drive internal-tangled (3 rqr)
16 Ring, retaining, internal
17 Clutch apply plate
18 Pin
19 Clutch plate, splitter direct-drive internal-splined (2 rqr)
20 Clutch plate, splitter direct-drive external-tangled
21 Ring, retaining, external
22 Spring, piston return
23 Piston, splitter direct-drive clutch
24 Hook-type seal ring
25 Packing, preformed, piston outer
26 Bushing
27 Pin, grooved (4 rqr)
28 Pinion spindle (4 rqr)
29 Pinion (4 rqr)
30 Spacer (8 rqr)
31 Washer, thrust (8 rqr)
32 Roller, bearing (88 rqr)

Figure 4-36—Continued

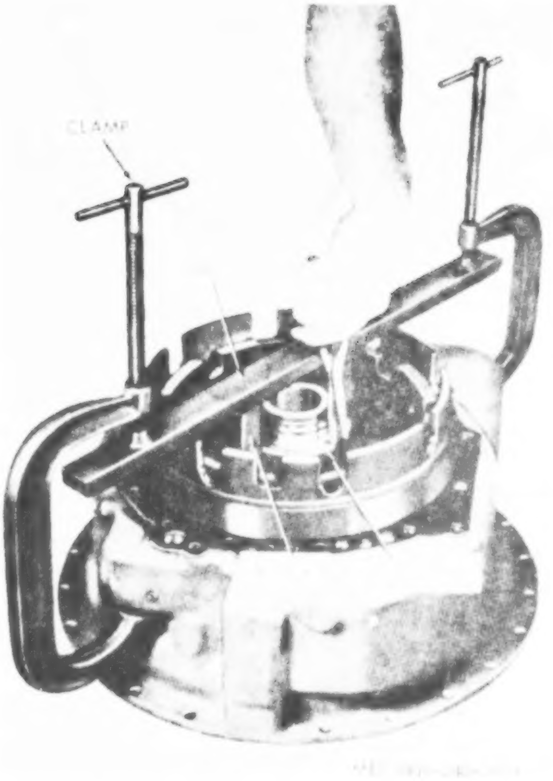


Figure 4-37. Ground sleeve snap ring removal.

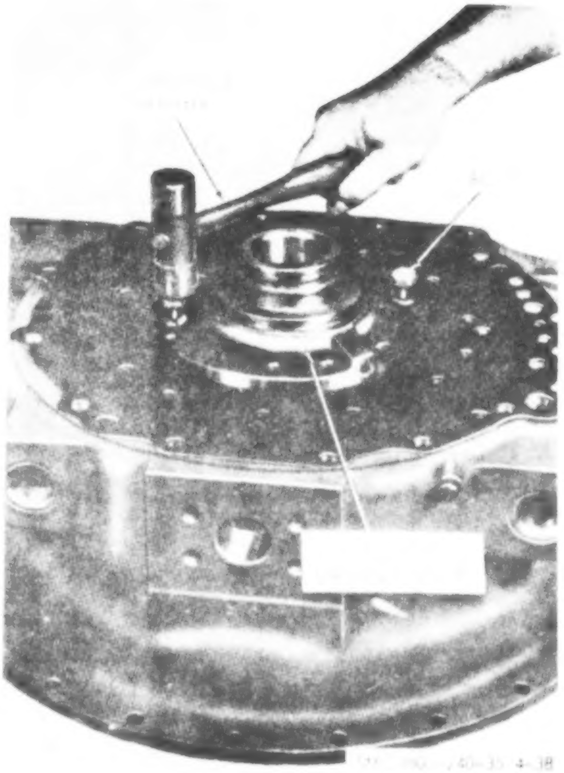
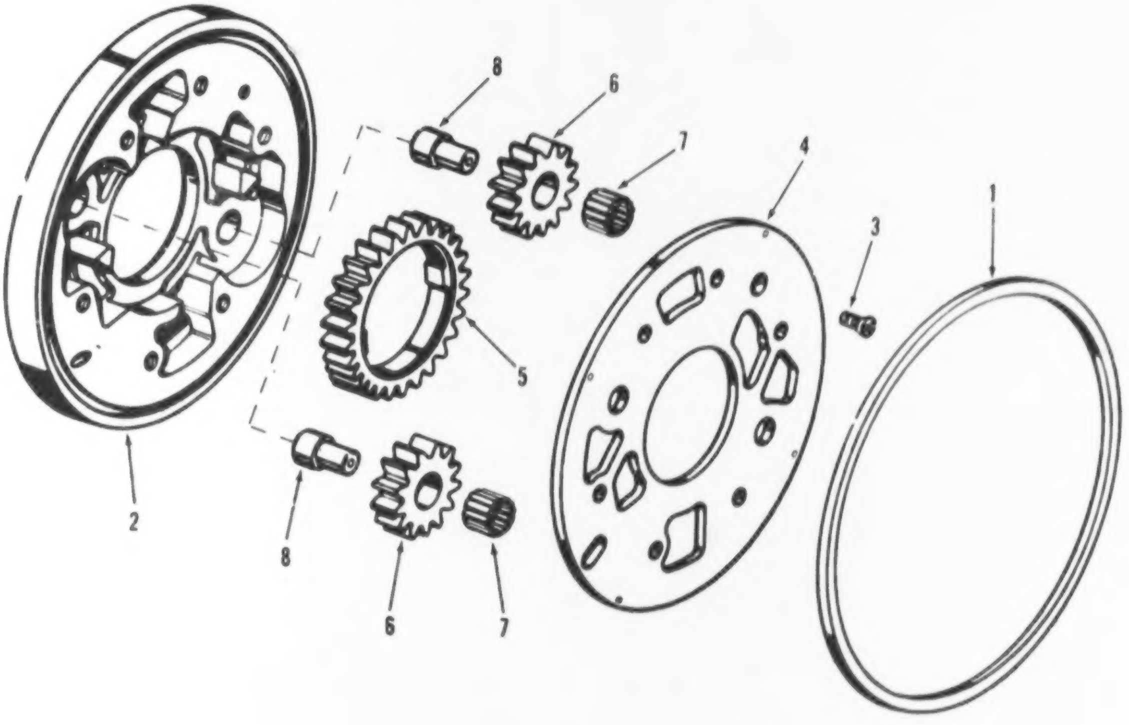


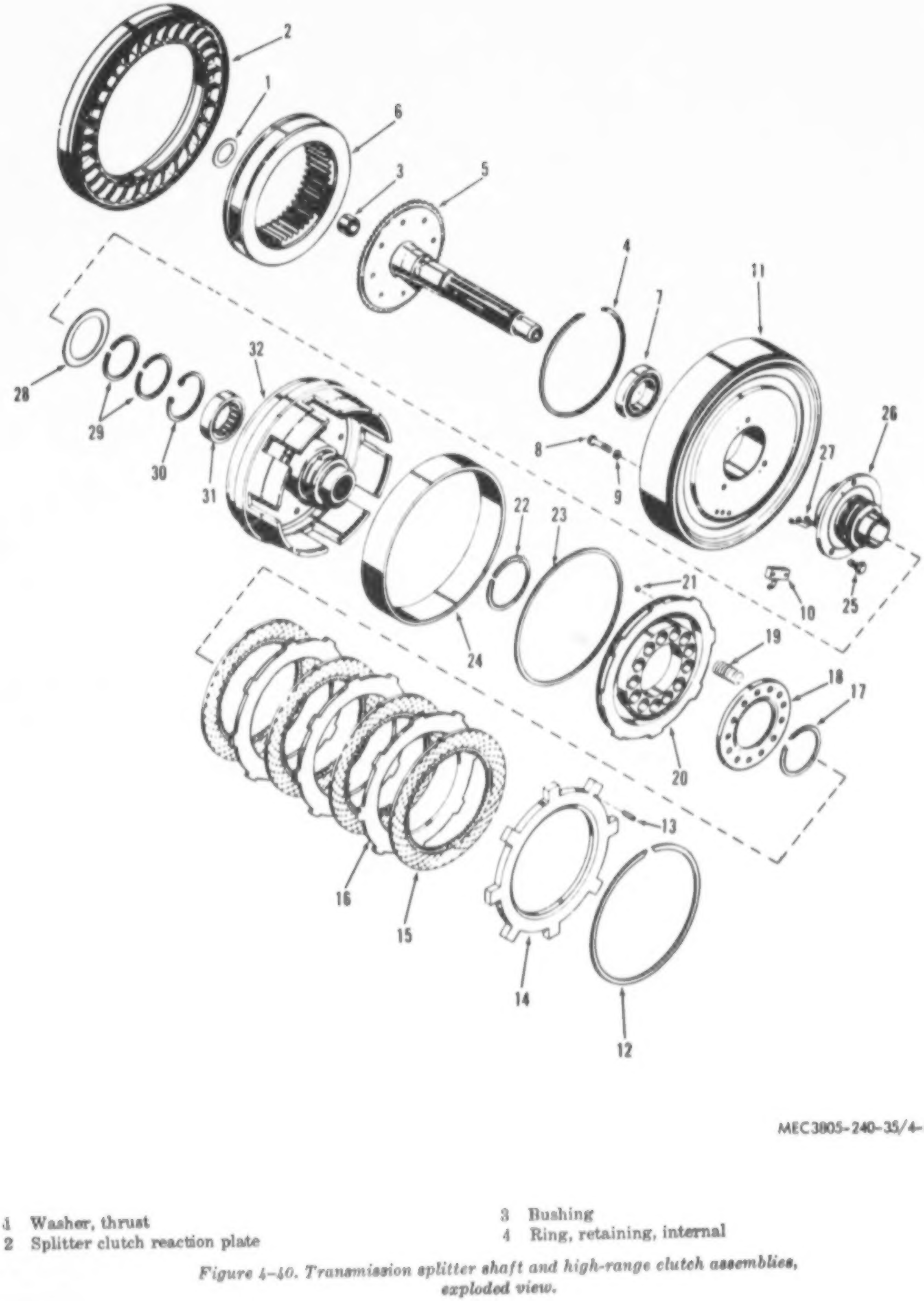
Figure 4-38. Loosening oil pump assembly.



MEC3805-240-35/4-39

1 Preformed packing
2 Body, oil pump
3 Screw, machine, flt hd, 1/4-20 x 5/8
4 Cover, oil pump
5 Gear, spur: drive
6 Gear, spur: Driven (2 rqr)
7 Roller, bearing (28 rqr)
8 Shaft, drive (2 rqr)

Figure 4-39. Transmission/torque converter charging oil pump assembly, exploded view.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MEC3805-240-35/4-40

1 Washer, thrust
2 Splitter clutch reaction plate
3 Bushing
4 Ring, retaining, internal

Figure 4-40. Transmission splitter shaft and high-range clutch assemblies, exploded view.

5 Splitter output shaft
6 Ring gear splitter
7 Bearing, ball
8 Bolt, 1/4-28 x 1 3/8 in. (2 rqr)
9 Washer, lock, 1/4-in. (. rqr)
10 Pitot tube
11 Diaphragm
12 Ring, retaining, internal
13 Pin, dowel
14 Clutch apply plate
15 Clutch plate, high-range internal-splined (4 rqr)
16 Clutch plate, high-range external-tanged (3 rqr)
17 Ring, retaining, external
18 Retainer, spring
19 Spring, clutch piston return (13 rqr)
20 Clutch piston
21 Ball, bearing (2 rqr)
22 Hook-type seal ring
23 Packing, preformed, piston outer
24 Sleeve
25 Bolt, self-locking, 3/8-16 x 4 3/4 in. (6 rqr)
26 Hub
27 Pin, dowel (3 rqr)
28 Washer, thrust
29 Hook-type seal ring (2 rqr)
30 Ring, retaining, internal
31 Bearing assembly, roller
32 High-range clutch housing

Figure 4-40—Continued

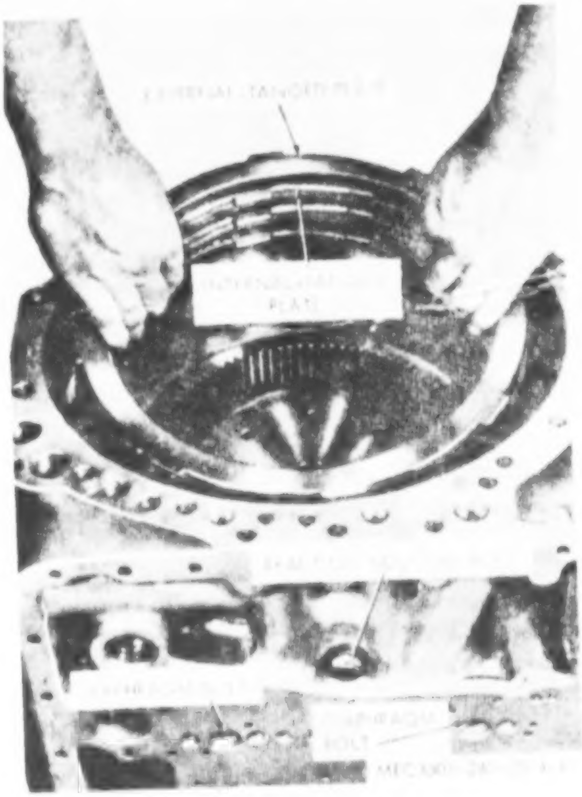


Figure 4-41. Splitter overdrive clutch plate removal.

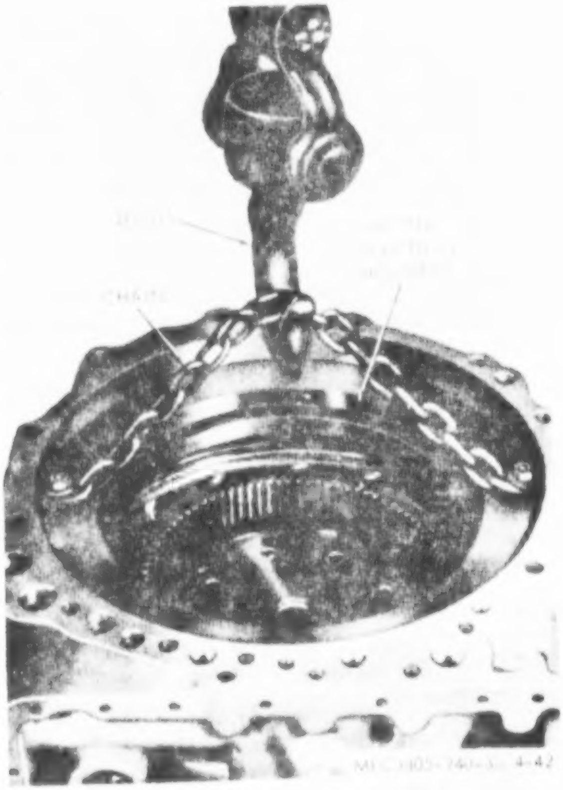


Figure 4-42. Splitter reaction housing removal.

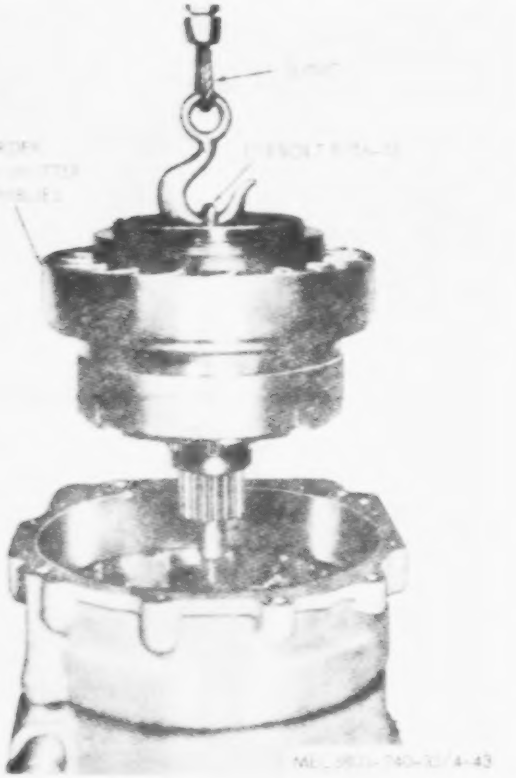


Figure 4-43. Splitter and high-range clutch assembly removal.

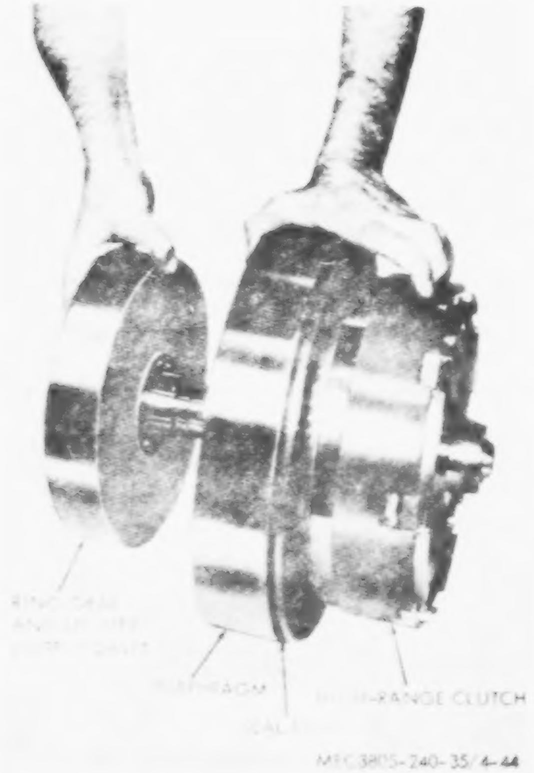


Figure 4-44. Splitter output shaft assembly removal.

Section V. TRANSMISSION/TORQUE CONVERTER ASSEMBLY CLEANING AND INSPECTION

4-31. General

a. Replace all preformed packing and gaskets with new parts when these have been removed from the transmission/torque converter and power take-off assemblies.

Caution: **Handle new preformed packings with care to prevent damage. Soak packings in transmission oil before installing.**

b. Paragraph 1-4 contains wear limits data for all transmission/torque converter and power take-off subassemblies. Refer to Paragraph 1-4 during inspection procedures and replace any components which fail to fall within the wear limits listed.

c. Inspect for dirt and abrasives. When the transmission contains dirt or other abrasive matter, unnecessary wear will result. Inspect all parts for abrasive material any time the transmission is disassembled. Metallic contamination of oil is evidence of the failure of some part. If metal particles are found, thoroughly clean the transmission and all components of the transmission hydraulic system.

4-32. Cleaning

a. Cleaning Metallic Parts.

(1) Clean all metallic parts of the transmission except bearings throughly with approved solvent, or by the live steam-cleaning method.

Caution: **Do not use caustic soda solution for steam cleaning.**

(2) Dry metallic parts with compressed air. Oil steam-cleaned parts immediately after drying.

(3) Clean oil passages by working a piece of wire back and forth through the passages and flushing them with approved cleaning solvent. Dry the passages with compressed air.

(4) Examine parts, especially oil passages, after cleaning to make certain they are entirely clean and reclean them if necessary.

b. Cleaning Bearings.

(1) Thoroughly wash bearings that have been in service in approved dry-cleaning solvent.

(2) If the bearings are filled with hardened grease, soak them in the solvent over night before trying to clean them.

(3) After inspection, oil bearings with the same type of oil that will be used in the transmission.

Caution: **Never dry bearings with compressed air. Do not spin bearings while they are not lubricated.**

c. Keep Bearings Clean. Since the presence of dirt or grit in ball bearings is usually responsible for bearing failures, it is important to keep bearings clean during installation and removal.

(1) Do not remove the wrapper from new bearings until ready to install them.

(2) Do not remove the grease in which new bearings are packed.

(3) Do not lay bearings on a dirty bench; place them on clean paper.

(4) If assembly is not to be completed at once, wrap or cover the exposed bearing with clean paper or cloth to keep out dust.

4-33. Inspection

a. Inspect Cast Parts, Machined Surfaces.

(1) Inspect bores for wear, scratches, grooves, and dirt. Remove scratches and burrs with crocus cloth. Remove foreign matter. Replace parts that are deeply grooved or scratched.

(2) Inspect all oil passages for obstructions. If an obstruction is found, remove it with compressed air or by working wire back and forth through the passage and flushing it with cleaning solvent.

(3) Inspect mounting faces for nicks, burrs, scratches, and foreign matter. Remove such defects with crocus cloth or a soft stone. If scratches are deep, replace the defective part.

(4) Inspect threaded openings for damaged threads. Chase damaged threads with the correct size tap.

(5) Replace housings or other cast parts that are cracked.

(6) Inspect all machined surfaces for damage that could cause oil leakage or other malfunction of the part. Rework or replace the defective parts.

b. Inspect Bearings.

(1) Inspect bearings for roughness of rotation. Replace a bearing if its rotation is still rough after cleaning and oiling.

(2) Inspect bearings for scored, pitted, scratched, cracked, or chipped races, and indication of excessive wear of rollers or balls. If one of these defects is found, replace the bearing.

(3) Inspect a defective bearing's housing and shaft for grooved, burred or galled conditions that would indicate that the bearing has been turning in its housing or on its shaft. If the damage cannot be repaired with crocus cloth, replace the defective part.

(4) When installing a bearing on a shaft, heat the bearing to 200° F. if suitable facilities, such as an electric oven, are available. Coat the mating surfaces with white lead and use the proper size of installation sleeve and a press to seat the bearing.

Caution: **If a bearing must be removed or installed without any sleeve, *be careful to press only on the race which is adjacent to the mounting surface.* If a press is not available, seat the bearing with a soft drift and a hammer, driving against the supported race.**

c. Inspect Bushings, Thrust Washers.

(1) Inspect bushings for sharp edges, roundness, scores, burrs, and evidence of overheating. Remove scores with crocus cloth. Remove burrs and sharp edges with a scraper or knife blade. If the bushing is out-of-round, deeply scored, or excessively worn, replace it.

Note. When it is necessary to cut out a defective bushing, be careful not to damage the bore into which the bushing fits.

(2) Inspect thrust washers for distortion, scores, burrs, and wear. Replace defective or worn thrust washers.

d. Inspect Seals, Packing, Gaskets.

(1) When replacing lip-type seal rings, make sure the spring-loaded side is toward the oil to be sealed in (toward the inside of the unit). Use an approved nonhardening sealing compound on the outside diameter of the seal to help prevent oil leaks.

(2) Replace all composition gaskets.

(3) Inspect hook-type seal rings for wear or broken hooks.

(4) If a hook-type seal ring shows any signs of wear on the outside diameter, replace the seal ring.

(5) The sides of the seal ring should be smooth (0.005-inch maximum side wear). The sides of the shaft groove (or the bore) in which the seal ring fits should be smooth (50 micro inches equivalent), and square (within 0.002 inch) with the axis of rotation. If the sides of the

ring grooves have to be reworked (0.020-inch maximum side wear), install a new seal ring.

e. Inspect Gears.

(1) Inspect gears for scuffed, nicked, burred or broken teeth. If the defect cannot be removed with a soft stone, replace the gear.

(2) Inspect gear teeth for wear that may have destroyed the original tooth shape. If this condition is found, replace the gear.

(3) Inspect the thrust faces of gears for scores, scratches, and burrs. Remove such defects with a soft stone. If scratches and scores cannot be removed with a soft stone, replace the gear.

f. Inspect Splined Parts. Inspect parts for stripped, twisted, chipped, or burred splines. Remove burrs with a soft stone. If other defects are found, replace the part. Spline wear is not considered detrimental except where it affects tightness of an assembly such as drive line flanges.

g. Inspect Threaded Parts. Inspect parts for burred or damaged threads. Remove burrs with a soft stone or fine file. Replace damaged parts.

h. Inspect Snap Rings. Inspect all snap rings for nicks, distortion, and excessive wear. Replace the part if one of these defects is found. The snap ring *must* snap tight in its groove for proper functioning.

i. Inspect Springs. Inspect springs for signs of overheating, permanent set or wear due to rubbing of adjacent parts. Replace the spring if any one of these defects is found. Check the dimensional and load specifications against the spring chart (para 1-4).

Section VI. REBUILD OF SUBASSEMBLIES

4-34. General

a. Tools, Parts, Methods. Refer to paragraph 2-2.

b. Cleaning, Inspection. Refer to paragraph 4-31 for cleaning and inspection instruction.

c. Torque Specifications. Refer to paragraph 1-4 for torque specifications for threaded fasteners.

d. Wear Limits. Refer to paragraph 1-4 for wear limits information.

4-35. Flex Disk Assembly—Rebuild (fig. 4-45)

a. Disassembly.

(1) Remove flex disk assembly (2 through 7) from the engine crankshaft.

(2) Remove twelve self-locking bolts (7) and separate plate (6), flex disks (4 and 5) and hub assembly (3) with pin (2).

b. Cleaning and Inspection. Refer to paragraphs 4-30 through 4-32 for cleaning and inspection instruction.

c. Assembly.

(1) Install flex disk (4) onto hub assembly (3), alining the dowel pin holes in the disk with pin (2).

(2) Install the flex disks (5) in the same manner.

(3) Install plate (6), alining the plate with dowel pin (2).

(4) Install twelve self-locking bolts (7) through plate (6) and disks (4 and 5) and into hub assembly (3).

(5) Install flex disk assembly on the engine crankshaft.

4-36. Oil Scavenge Pump—Rebuild (fig. 4-33)

a. Disassembly.

(1) Place oil scavenge pump assembly on the assembly table with external-drive gear (10) down and remove two snap rings (4).

(2) Remove oil scavenge pump body plate (5).

(3) Remove snap ring (6) from the shaft of drive gear (10).

(4) Remove driven gear (7) from spindles (13).

(5) Remove gear (8) from external-drive gear shaft (10). Remove lock roller (9) from gear (10).

(6) Remove gear (10) from pump body (3).

(7) If necessary for parts replacement, press needle bearing (11) out of body (3). Press needle bearing (12) out of plate (5).

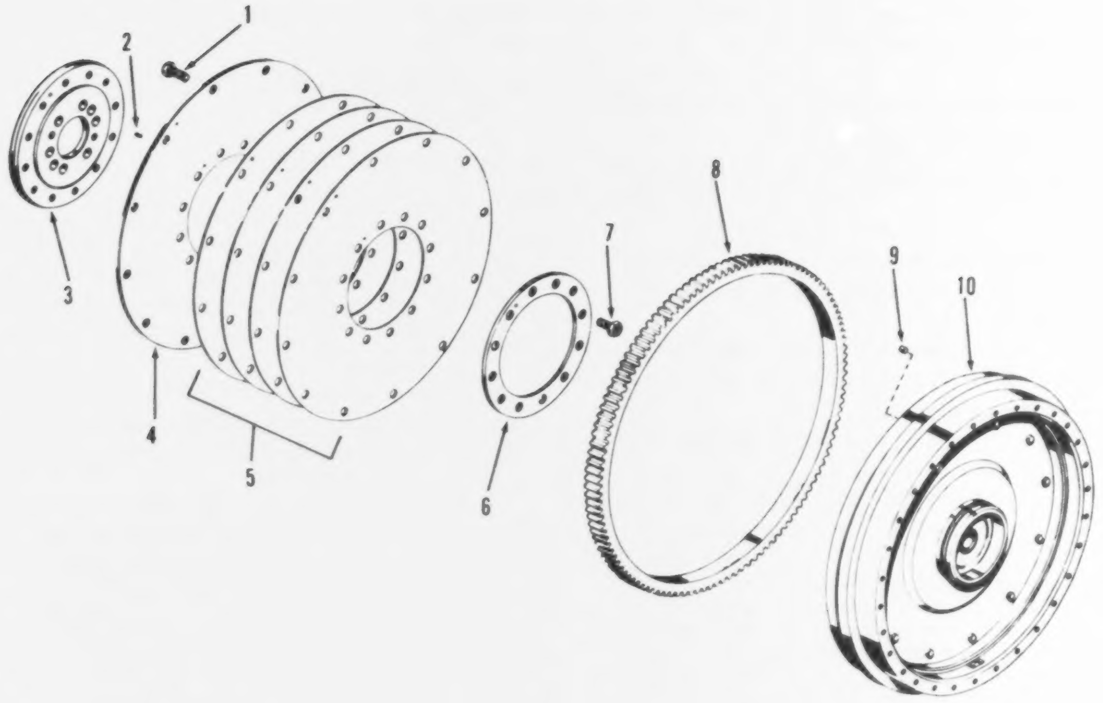
(8) If necessary for parts replacement, press spindles (13) toward the inside of body (3). Press out bushing (14) from gear (7)

b. Cleaning and Inspection. Refer to paragraphs 4-30 through 4-32 for cleaning and inspection instruction.

c. Assembly.

(1) If spindles (13) were removed, install spindles into the inside of body (3) with snap ring ends projecting toward the inside of the body. Press the spindles to 1.0 inch above the inside surface of the body.

(2) If needle bearing (11) was removed, press a new bearing to 0.04 inch below the outside surface of body (3).



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1	Bolt, self-lkg, 1/2-20 x 1 (12 rqr)	6	Plate, flywheel
2	Pin, dowel	7	Bolt, self-lkg, 1/2-20 x 3/4 (12 rqr)
3	Hub, body	8	Gear, ring
4	Insert, front	9	Pin, dowel
5	Insert, rear (4)	10	Flywheel, engine

Figure 4-45. Flex disk and flywheel assemblies, exploded view.

(3) If bearing (12) was removed, press a new bearing flush to 0.01 inch below the outside surface of plate (5).

(4) Install pump drive gear (10) into body (3) and install lock roller (9) into its groove in the shaft of gear (10). Install internal-drive gear (8) onto the shaft of gear (10), alining the lock roller with the groove in the gear. Secure the gear with snap ring (6).

(5) If bushing (14) was removed, press new bushing into gear (7) to 0.03 inch below the gear surface. Install driven gear onto spindle (13) nearest tube (15).

(6) Install plate (5) onto body (3). Install snap rings (4) onto spindles (13).

4-37. Input Driven Charging Oil Pump — Rebuild (fig. 4-39)

a. Disassembly.

(1) Place pump assembly on the assembly table with cover (4) up and remove screw (3) from the pump. Remove cover (4) from pump body (2).

(2) Remove drive gear (5) and driven gears (6) from the pump body. Remove roller bearings (7) from driven gear shafts (8).

(3) If necessary for parts replacement, remove shafts (8) from pump body (2).

b. Cleaning and Inspection. Refer to paragraphs 4-30 through 4-32 for cleaning and inspection instructions.

c. Assembly.

(1) If shafts (8) were removed, install each shaft into pump body (2) with the larger diameter first. Press the shafts flush to 0.10 inch below the pump body surface.

(2) Coat the shafts with grease and install driven gears (6) onto the shafts. Install roller bearings (7) into the gears.

(3) Install drive gear (5) into pump body (2), meshing the teeth with the driven gear teeth.

(4) Install cover (4) onto pump body (2). Secure the cover with screw (3). Make sure the screw is below the surface of cover (4).

4-38. Splitter Planetary — Rebuild (fig. 4-36)

a. Disassembly of Planetary.

(1) Place splitter planetary carrier assembly (9, 27 through 32) on its side and drive pins (27) toward the center of the carrier.

(2) Place the carrier assembly in a press with the shaft end up and press each of spindles (28) from carrier (9).

(3) As a unit, remove pinion (29), two spacers (30), two thrust washers (31) and twenty-two needle rollers (32).

(4) Remove the three remaining pinions and related parts in the same manner.

b. Cleaning and Inspection. Refer to paragraphs 4-30 through 4-32 for cleaning and inspection instructions.

c. Assembly of Planetary.

Note. If facilities are available, chill spindles (28) in dry ice for one hour before installing them in the planetary carrier.

(1) Grease a thrust washer (31) and spacer (30) and install them onto one end of pinion (29).

(2) Grease the bore of splitter planetary pinion (29) and install one set of twenty-two needle rollers (32) into the pinion bore. If available, place an alining tool in the pinion bore to hold the rollers in place while installing.

Note. An alining tool can be made by grinding a discarded spindle 0.005 undersize and brazing a handle on one end.

(3) Grease a thrust washer (31) and spacer (30) and install them on the other end of pinion (29). Remove the alining tool if one was used. Assemble the other pinions and related parts in the same manner.

(4) Install a pinion and attached parts into carrier (9), alining the pinion with the spindle hole in the carrier.

(5) Place carrier (9) into a press with the shaft up.

(6) Aline the pin groove in spindle (28) with the pin bore in the carrier and press the spindle into the carrier flush to 0.10 inch below the carrier surface. Install the remaining pinions and attached parts in the same manner.

(7) Remove the carrier from the press and place it on its side. Drive new pins (27), smooth end first, into the carrier to secure the pinions. Drive the pins 0.003 to 0.006 inch below the carrier surface (bottom of spline teeth) and stake metal over the pins in two places with a center punch.

4-39. Splitter Direct-drive Clutch-rebuild (fig. 4-36)

a. Disassembly of Direct-drive Clutch Assembly

(1) Using a heavy screwdriver at the pin (18) in the clutch back plate (17), remove the clutch plate retaining snap ring (16).

(2) Remove clutch back plate (17) and internal-splined (19) and external-tanged (20) plates.

(3) Using a press and a spring compressor, remove the snap ring (21) from the clutch housing (11). See figure 4-46. Remove the piston return spring (22, fig. 4-36).

(4) Remove the piston (23) from the clutch housing. Remove the seal ring (25) from the piston outside diameter and the seal ring (24) from the hub of the housing.

b. Cleaning and Inspection. Refer to paragraphs 4-30 through 4-32 for cleaning and inspection instructions.

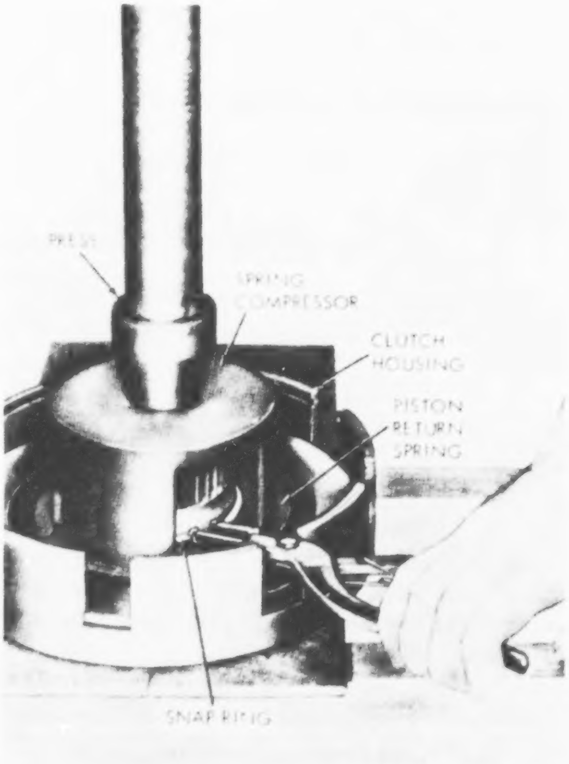

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Figure 4-46. Splitter direct-drive clutch spring snap ring removal or installation.

c. Assembly of Direct-drive Clutch Assembly.

(1) Install the seal ring (24) onto the hub of the clutch housing (11). Install the seal ring (25) into the piston outside diameter groove.

(2) Install the piston assembly (23) into the housing (11). Install the piston return spring (22), concave side down and, using a press and spring compressor, install the spring retaining snap ring. See figure 4-46.

(3) Install one internal-splined clutch plate (19, fig. 4-36), external-tanged plate (20) and another internal-splined plate (19). Install the clutch back plate (17) and retaining snap ring (16).

4-40. High-range Clutch Assembly — Rebuild (fig. 4-40)

a. Disassembly.

(1) Using a heavy screwdriver at the pin (13) in the clutch back plate (14), remove the plate retaining snap ring (12).

(2) Remove the clutch back plate (14), internal-splined (15) and external-tanged (16) clutch plates and the sleeve (24).

(3) If the bearing (31) inside the clutch housing needs to be replaced, remove the snap ring (30) and remove the bearing.

(4) Block up so no pressure is on the governor oil collector ring and, using a press, remove the snap ring (17) holding the clutch spring retainer (18).

***Caution:* Do not remove the snap ring without using a press, as the springs are under heavy pressure.**

(5) Remove the spring retainer (18) and thirteen coil springs (19).

(6) Tap out the piston (20) and remove the seal ring (23) from the piston outside diameter and the seal ring (22) from the housing hub.

b. Cleaning and Inspection. Refer to paragraphs 4-30 through 4-32 for cleaning and inspection instructions.

c. Assembly.

(1) Install the seal ring (23) into the piston outside diameter groove and the seal ring (22) into the groove in housing hub. Install the piston (20) into the housing.

(2) Install thirteen piston return coil springs (19) and spring retainer (18).

(3) Block up under the housing to prevent damage to governor oil collector ring. Using a press, compress the piston return springs and install the retainer snap ring (30).

(4) If the bearing (31) was removed from the housing, press in a new bearing by pressing on the outside of the bearing race. Install the snap ring (30).

(5) Install the sleeve (24) on the housing. Beginning with an internal-splined clutch plate (15), alternately install four internal-splined and three external-tanged (16) clutch plates into the housing.

(6) Install the clutch back plate (14) and retaining snap ring (12).

4-41. Transmision Main Housing — Rebuild (fig. 4-16)

a. Disassembly.

(1) Only if necessary for parts replacement, remove sleeve (25) from the left side of housing (50).

(2) Only if necessary for parts replacement, remove sleeve (2), valve guide (3), converter-out pressure regulator valve (4) and spring (5) from the housing.

(3) Remove bolts (6 and 10) and lockwashers (7 and 11) and remove covers (8 and 12) and gaskets (9 and 13).

b. Cleaning and Inspection. Refer to paragraphs 4-30 through 4-32 for cleaning and inspection instructions.

c. Assembly.

(1) If converter-out pressure regulator valve (4) was removed, install spring (5), valve (4) (concave side inward) and valve guide (3) into housing (50).

(2) Press valve guide (3) to 1.90 inch below the housing surface.

(3) Press sleeve (2) into housing (50) flush to 0.030 below the housing surface.

(4) If sleeve (25) was removed, press a new sleeve into housing (50) until firmly seated.

(5) Install gaskets (9 and 13). Install covers (8 and 12). Install the bolts (6 and 10) and washers (7 and 11) which retain the covers.

4-42. Intermediate And Low-Range Planetaries — Rebuild (fig. 4-22)

a. Disassembly.

(1) Place intermediate-range carrier (12) on its side and drive each pin (6) toward the center of the carrier.

(2) Place carrier assembly in a press with the long splines downward and press each of the six spindles (7) from carrier (12).

(3) As a unit, remove pinion (8), two spacers (9), two thrust washers (10) and twenty-one needle rollers (11).

(4) Remove the five remaining pinions and related parts in the same manner.

(5) Place low-range carrier (19) on its side and drive pins (13) toward the center of the carrier.

(6) Place carrier assembly in a press with the hub up and press each of four spindles (14) from carrier (19).

(7) As a unit, remove pinion (15), two spacers (16), two thrust washers (17) and twenty needle rollers (18).

(8) Remove three remaining pinions and related parts in the same manner.

b. Cleaning and Inspection. Refer to paragraphs 4-30 through 4-32 for cleaning and inspection instructions.

c. Assembly.

Note. If facilities are available, chill spindles (7) and (14) in dry ice for one hour before installing into carriers.

(1) Grease the bores of intermediate-range pinions (8) and install one set (twenty-two) of needle rollers (11) into each pinion bore. If available, place an alining tool in the bore of each pinion to hold the rollers in place while installing. An alining tool can be made by grinding a discarded spindle to 0.005 inch undersize.

(2) Grease thrust washers (10) and spacers (9) and install them (spacers first) at each end of pinions (8).

(3) Install each pinion and attached parts into carrier (12), alining the pinions with the spindle holes in the carrier.

(4) Place carrier (12) and related parts into a press with the long splines down.

(5) Aline the pin grooves in the spindles with the pin bores in the carrier and press the spindles into the carrier, 0.025 to 0.035 inch below the carrier surface.

(6) Remove the carrier from the press and place it on its side. Drive new pins (6), smooth diameter first, into the carrier to secure the pinions. Drive the pins into the carrier 0.03 to 0.06 inch below the carrier surface and stake metal over each pin in two places with a center punch.

(7) Grease the bores of low-range pinions (15) and install one set of twenty needle rollers (18) into each bore. If available, place an alining tool in the bore of each pinion to hold the rollers in place while installing. See (1), above.

(8) Grease thrust washers (17) and spacers (16) and install (spacers first) at each end of pinions (15).

(9) Install each pinion and attached parts into carrier (19), alining the pinions with the spindle holes in the carrier.

(10) Place low-range carrier (19) into a press with the hub up.

(11) Aline pin grooves in spindles (14) with the pin bores in the carrier and press the spindles into the carrier flush to 0.010 inch below surface of the carrier.

(12) Remove the carrier from the press and turn it on its side. Drive new pins (13), smooth diameter first, into their bores in the carrier. Drive the pins 0.03 to 0.06 inch below the surface of the carrier and stake metal over the pin in two places with a center punch.

4-43. Reverse-Range Planetary and Output Drive Shaft — Rebuild (fig. 4-17)

a. Disassembly.

(1) Place reverse-range carrier (7) on its side and drive each pin (1) toward the center of the carrier.

(2) Place the carrier in a press with the hub up and press out each of six pinion shafts (2) from carrier (7).

(3) As a unit, remove pinion (3), two spacers (4) two washers (5) and twenty-two needle rollers (6).

(4) Remove the five remaining pinions and related parts in the same manner.

(5) Do not remove bushing (8) unless replacement is necessary

b. Cleaning and Inspection. Refer to paragraphs 4-30 through 4-32 for cleaning and inspection instructions.

c. Assembly.

Note. If facilities are available, chill pinion shafts (2) in dry ice for one hour before installing into carrier.

(1) Grease the bores of reverse-range pinions (3) and install one set (twenty-two) of needle rollers (6) into each pinion bore. If available, place an alining tool into each pinion to hold the rollers in place while installing. An alining tool can be made by grinding a discarded spindle to 0.005 inch undersize.

(2) Grease thrust washers (5) and spacers (4) and install them at each end of pinions (3).

(3) Install each pinion and attached parts into carrier (7), alining the pinion with the spindle hole in the carrier.

(4) Place carrier (7) and related parts in a press with the hub up.

(5) Aline the pin grooves in the spindles with the pin bores in the carrier and press the spindles into the carrier to within 0.010 inch of the carrier surface.

(6) Remove the carrier from the press and place it on its side. Drive new pins (1) into the carrier to secure the spindles. Drive the pins flush to 0.030 inch below the carrier surface. Stake metal over each pin in two places with a center punch.

(7) If bushing (8) was removed from the output shaft, install a new bushing. Press the bushing into the front of the shaft until it is 0.040 to 0.080 inch below the surface adjacent to the bore.

4-44. Control Valve and Oil Transfer Plate — Rebuild (fig. 4-14)

a. Disassembly.

(1) Remove five bolts (10) and lock washers (11) from cover (12). Remove cover (12) from housing (4).

(2) Using pliers, remove small retaining pin (13) from rear cover (23).

(3) Remove pin (14), outer spring (15) and outer ball (16).

(4) Remove pin (17) from manual selector valve (18) only if replacement is necessary.

***Caution:* Cover (23) is heavily spring loaded. Compress it while removing bolts (19) and (21) in (5), below.**

(5) Remove seven bolts (21) and lock washers (22). Remove three bolts (19) and lock washers (20) from rear cover (23).

(6) Remove rear cover (23).

(7) Remove the remaining detent ball (16) and spring (15) from the rear cover.

(8) Remove plug valve spring (24) and plug (25) from the rear cover.

(9) Remove lockup valve spring (26) and lockup plug (27) from the rear cover.

(10) Remove pilot valve (28) from valve housing (4).

(11) Remove lockup valve spring washer (29), lockup shift valve (30), flow valve (31), manual selector valve (18) and stop washer (32) from the valve body.

(12) Remove plug (33), gasket (34), main-pressure regulator valve (35) and spring (36) from the valve body.

(13) Do not remove valve assemblies (37), (38) and (39) or remaining minor items from valve housing (4) unless necessary for parts replacement.

(14) Do not remove valve (48) and plugs (46, 47 and 50) from oil transfer plate (9) unless replacement is necessary.

b. Cleaning and Inspection. Refer to paragraphs 4-30 through 4-32 for cleaning and inspection instruction

c. Assembly.

(1) If valve assembly (48) was removed from oil transfer plate (9), install a new valve assembly flush, to slightly below the oil transfer plate surface. If plugs (46, 47 or 50) were removed, replace them.

(2) If valve assemblies (37, 38 or 39) were removed from valve housing (4), install new valve assemblies flush, to slightly below, the valve body surface. If other minor parts were removed, replace them.

(3) Install main-pressure regulator valve spring (36) into its bore in the front of valve housing (4).

(4) Install main-pressure regulator valve (35) into the same bore and retain the valve gasket (34) and plug (33).

(5) Position valve housing (4) with the rear end up and install manual selector valve (18) with stop washer (32), flow valve (31), lockup shift valve (30) (larger end first), washer (29) and plug valve (28).

(6) Coat plug valve spring (24), and plug (25) with oil-soluble grease and install them into rear cover (23).

(7) Coat lockup shift valve plug (27) and spring (26) with oil-soluble grease and install them into rear cover (23).

(8) Install one detent spring (15) and ball (16) into cover (23) and install the cover. Compress the valve springs to seat the cover. Ball (16) and spring (15) will have to be depressed to engage detents on selector valve (18).

(9) Install seven bolts (19) and lock washers (20) into the rear cover.

(10) Install three bolts (21) and lock washers (22) into the rear cover. Torque the ten bolts to 9 to 11 pound feet.

(11) Install the remaining detent ball (16), spring (15), and pin (14). Retain pin (14) with pin (13) so that the end of pin (13) projects 0.12 inch above the rear cover surface.

(12) Install bottom cover (12) onto valve housing (4), and retain it with five bolts (10) and lock washers (11).

4-45. Converter Pressure Regulator Valve — Rebuild (fig. 4-12)

a. Disassembly.

(1) Remove three bolts (14) and lock washers (15) and remove retainer (16) from the end of converter pressure regulator valve housing (13).

***Caution:* The retainer is heavily spring loaded.**

(2) Remove converter pressure regulator valve spring (17) and lubrication regulator valve spring (18).

(3) Remove lubrication regulator valve (19), converter regulator valve (20) and spring (21).

(4) Remove snap ring (22) from the opposite side of valve housing (13). Remove pin (23) and guide washer (24).

(5) Remove snap rings (25) and (26). Remove seat (27) and converter-in pressure regulator valve (28).

b. Cleaning and Inspection. Refer to paragraphs 4-30 through 4-32 for cleaning and inspection instructions.

c. Assembly.

(1) Install lubrication regulator valve (19), stepped stem first, into valve housing (13). Install spring (18) into the same bore.

(2) Install converter regulator valve (20), open end first, into valve housing (13). Install spring (17) into the same bore.

(3) Install retainer (16) with the offset over spring (17). Apply hand pressure on the retainer and install three bolts (14) and lock washers (15).

(4) Install spring (21) into the converter pressure regulator valve bore in valve housing (13). Install converter-in pressure regulator valve (28) into the same bore with the concave side next to the spring.

(5) Install valve seat (27) and snap rings (26 and 25).

(6) Install guide pin (23), guide washer (24) and snap ring (22).

Section VII. TRANSMISSION/TORQUE CONVERTER ASSEMBLY FROM SUBASSEMBLIES AND INSTALLATION

4-46. General

a. Arrangement of Assembly Procedures.

(1) The procedures in this section describe the assembly of the transmission from subassemblies.

(2) Refer to the cross-section drawing (fig. 4-1) for functional location of parts. Refer to figure 4-3 and other exploded views for parts identification.

(3) The components of each gear, other than high range are identified at the factory by color code (red for reverse range, green for low range, and yellow for intermediate range). Because of the similarity of several components, this is especially helpful in assembling the transmission. Replacement parts are not color coded.

b. Preparation for Assembly.

(1) Refer to paragraphs 4-31 through 4-33 before beginning assembly.

(2) Refer to paragraph 1-4 for general torque specifications when specific values are not given in the assembly step.

4-47. Testing Clutch Stack Clearance

Note. **Before final assembly of the transmission, it is necessary to check the clearance of the stack for the low- and reverse-range clutches. The purpose of this check is to insure sufficient free space between elements of each clutch to minimize clutch plate drag. Replacement of any of the elements of either pack will require rechecking the clearances. The following description covers the clearance check procedure.**

a. Install two packings (12 and 13, fig. 4-19) on the outside diameter of the hub of low- and reverse-range clutch piston housing (9).

b. Install packings (10) and (8) into the grooves in the outside diameters of low-range and reverse-range (7) clutch pistons.

c. Place the low- and reverse-range piston housing (9) in a press with the reverse side (red) up and install the reverse-range piston (7).

d. Install the reverse-range (red) piston return spring (6) with the concave side up (spring inner circle toughing piston).

e. Install the clutch apply plate (5) with the flat surface up, one internal-splined (3), one external-tanged (4) and another internal-splined (3) clutch plate. Install the reverse-range clutch reaction housing (1) over the tangs of the external-tanged clutch plates.

f. Place a heavy bar across the reaction housing and compress the assembly with enough force (4000 lbs. minimum), so that the piston housing and the reaction housing are compressed together.

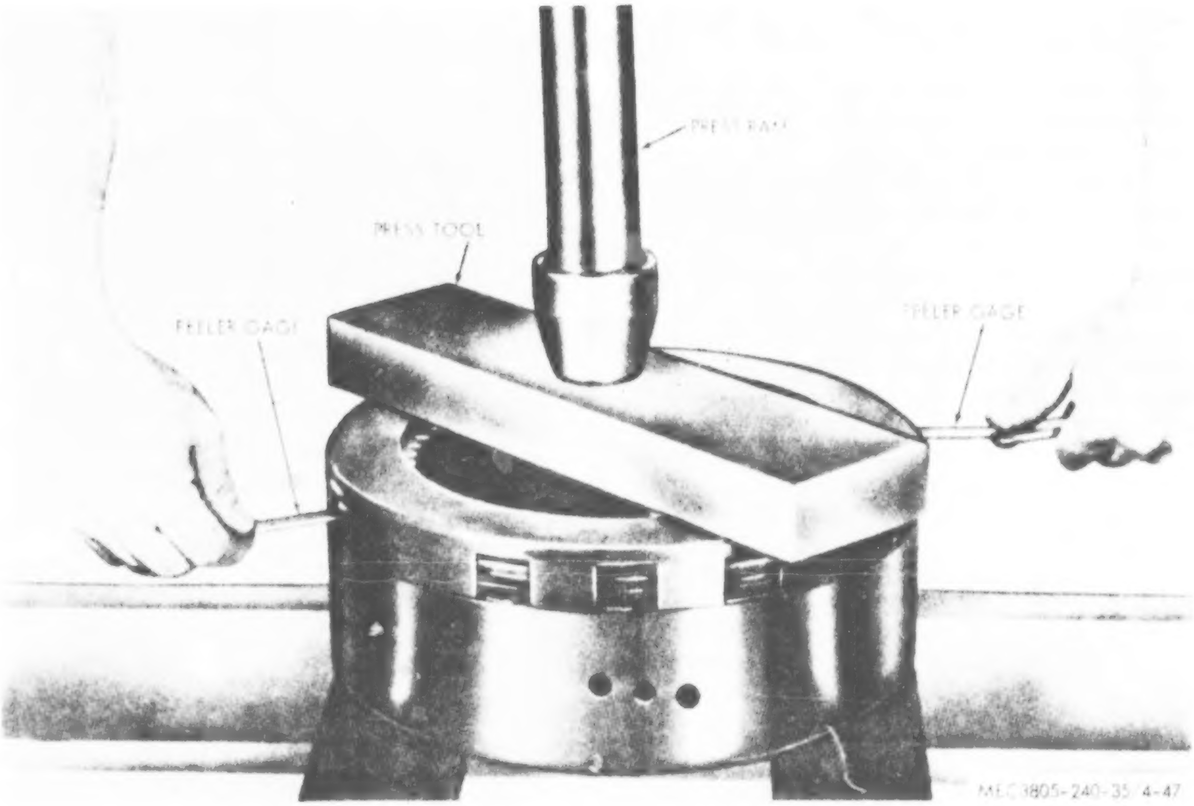

Figure 4-47. Clutch pack clearance check.

g. Using two feeler gages at points 180 degrees apart, check the clearance between the clutch plates in four places (fig. 4-47).

h. The desired average for the four readings is 0.030 to 0.044 inch. No readings should be less than 0.018 inch. The maximum average clearance for satisfactory operation is 0.054 but wear beyond this dimension may impair operation of the transmission. If the desired clearance is not obtained, the clutch apply plate or clutch reaction housing must be replaced. The apply plate is available in three thicknesses:

0.522 to 0.518 inch
0.532 to 0.528 inch
0.544 to 0.540 inch

i. Follow the same procedure described in (1) through (8), above, to check the clutch pack clearance for the low-range (green) clutch pack.

4-48. Assembly

a. Installation of High-range Clutch Assembly and Splitter Shaft into Main Housing (fig. 4-40).

(1) Position the diaphragm assembly (11) on its edge and install two hook-type seal rings (29) onto the hub (26). Position tube (10) onto the hub side of the diaphragm.

Caution: **The oil passage hole in the center of one side of the tube must face the oil passage hole in the diaphragm.**

(2) Install only one bolt (8) and lock washer (9), finger tight, through the diaphragm and into one of the pitot tube holes. Place the diaphragm front downward and install the thrust washer (28) onto the hub of the diaphragm.

(3) Install the high-range clutch assembly (12 through 24 and 32) onto the diaphragm assembly. Check the position of the pitot tube to see that it has not shifted.

(4) Carefully turn the assembly on its edge. Hold the high-range clutch assembly and the diaphragm together with one hand so that they do not separate and damage the pitot tube. Rotate bolt (A, fig. 4-48) clockwise until the bolt holes are alined and install bolt B. Torque the bolts to 10 to 12 pound feet.

Note. It may be necessary to first loosen bolt A slightly, and position the assembly with the high-range clutch downward to aline the holes for bolt B.

(5) Install the splitter shaft (5, fig. 4-40) and ring gear (6) assembly into the diaphragm (11) and high-range clutch assembly.

(6) Carefully turn the assembly to rest on the splitter ring gear (6) and install the intermediate-range sun gear (4, fig. 4-22) with bearing (3). Install the low-range sun gear (2) and secure it with the snap ring (1).

(7) Position the transmission housing to rest on its rear split line. Install a 9/16-18 bolt and chain or a lifting eye into the splitter shaft and raise the assembly from the table (fig. 4-49). Lower the assembly into the front of the transmission housing, alining the bolt holes in the diaphragm with the counter-bored holes in the transmission housing.

(8) Install one 5/16-18 x 3-inch bolt (29, fig. 4-16), flat washer (32) and lock washer (31) into the hole on the left side (right side in illustration), and one 5/16-18 x 2 1/4 inch bolt (30), flat washer (31) and lock washer (32) into the hole on the right side (left side in illustration) of the diaphragm. Torque the bolts to 15 to 18 pound feet.

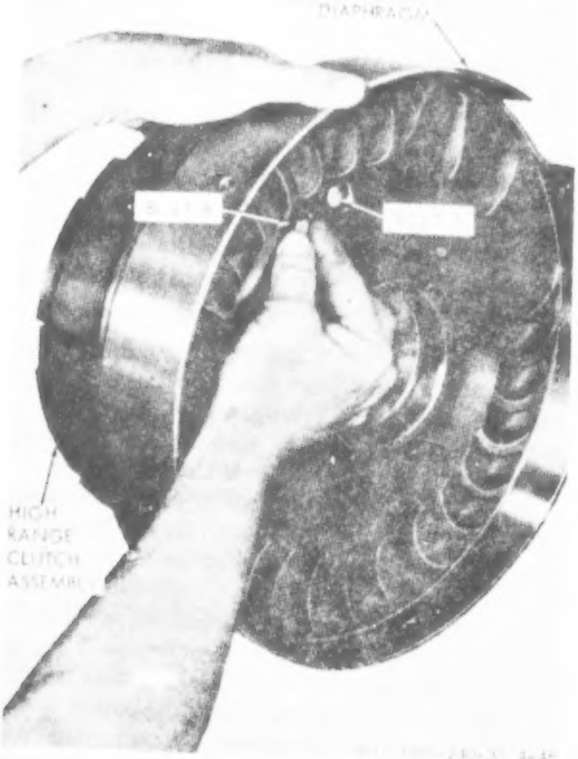

Figure 4-48. Second pitot tube bolt installation.

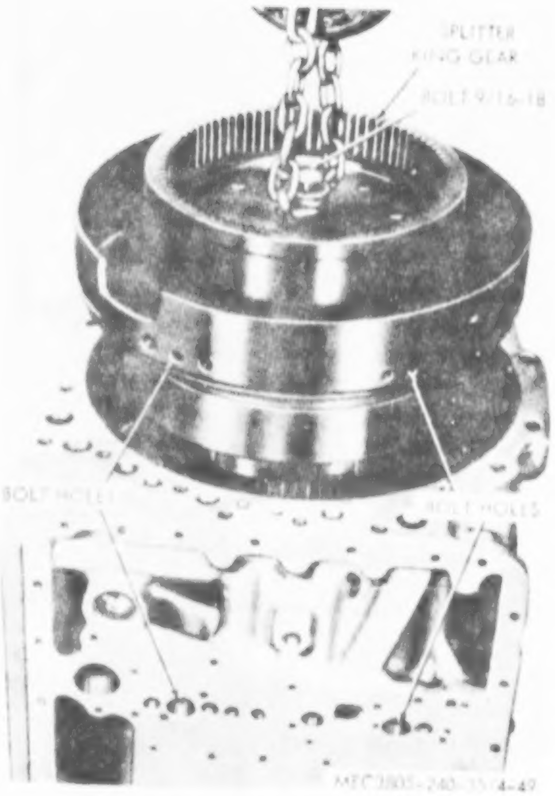

Figure 4-49. High-range clutch splitter output shaft assembly installation.

b. Installation of Splitter Clutch and Gearing (fig. 4-36).

(1) Install two 3/8-16 bolts into the splitter reaction plate (2, fig. 4-40) and lower it into the front of the transmission housing (fig. 4-50). Aline the bolt hole in the reaction housing with the bolt hole in the transmission housing.

(2) Install the 1/2-13 x 2 1/2-inch bolt (26, fig. 4-16), flat washer (28) and lock washer (27) into the reaction housing. Torque the bolt to 67 to 80 pound feet. Beginning with an internal-tanged plate (15, fig. 4-36), alternately install three internal-tanged (15) and three external-tanged (14) splitter overdrive clutch plates. Dip the plates in transmission oil before installing them.

(3) Using oil-soluble grease, grease the thrust washer (12) and install it onto the turbine shaft and carrier assembly (9). Install the small hook-type seal ring (13) at the end of the shaft.

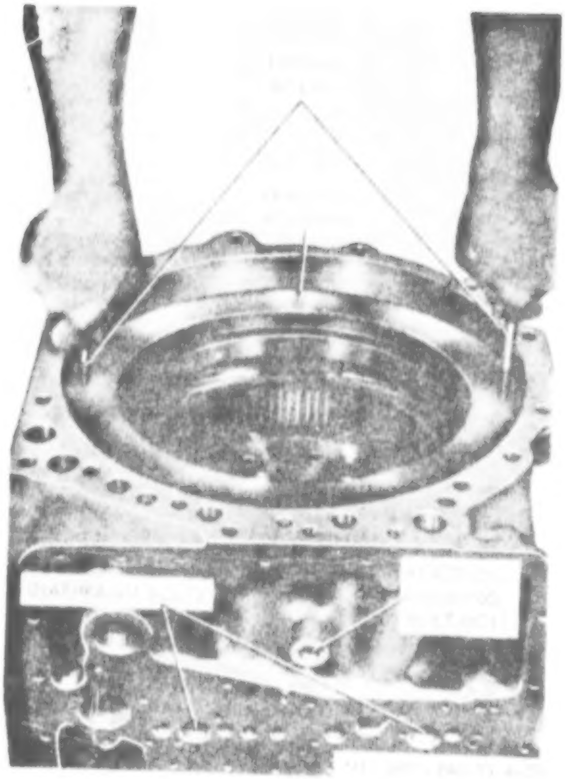

Figure 4-50. Splitter reaction housing installation.

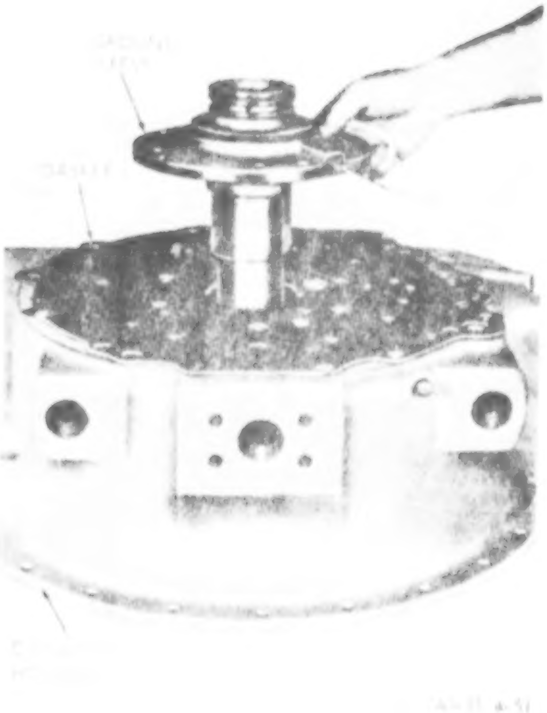

Figure 4-51. Torque converter ground sleeve installation.

(4) Install a second thrust washer (1, fig. 4-40), retained by oil-soluble grease, onto the rear side of the carrier assembly. Install the carrier assembly onto the splitter direct drive housing (11, fig. 4-36). Aline the splines on the carrier hub with the internal-splined splitter direct-drive clutch plates.

(5) Invert the assembly and install three hook-type seal rings (10) into the grooves in the turbine shaft (9).

(6) Install splitter direct-drive clutch and planetary assembly into the transmission, engaging the slots in the clutch housing with the internal tangs of the splitter overdrive clutch plates.

c. Installation of Converter Housing (fig. 4-13) and Oil Pump (fig. 4-39).

(1) Position the torque converter housing (23, fig. 4-13) on the assembly table with the front side down and install the gasket (10). Coat the converter ground sleeve (9) with white lead and install it with the plug in the sleeve toward the From Filter opening in the converter housing (fig. 4-51).

(2) Install the seal ring (1, fig. 4-39) on the outside diameter of the charging oil pump assembly and coat it with grease (fig. 4-52). Place the converter housing on its edge and install the pump assembly. Aline the oil port in the pump with oil passage in the converter housing (fig. 4-52).

(3) Secure the pump and ground sleeve with six bolts (6, fig. 4-13) and lock washers (7). Torque the bolts to 67 to 80 pound feet.

(4) Position the converter housing to rest on its rear side and install the splitter overdrive clutch piston housing (8, fig. 4-36). Secure the piston housing with eleven self-locking bolts (7). Torque the bolts to 36 to 43 pound feet.

(5) Install seal rings (5 and 6) on the outside diameter and the inside diameter of the splitter overdrive piston (4). Grease the seal rings and install the piston into the piston housing alining the slots in the piston with the slots in the piston housing.

(6) Install the splitter overdrive piston return spring (3) with the convex side up (spring angle up at inside diameter).

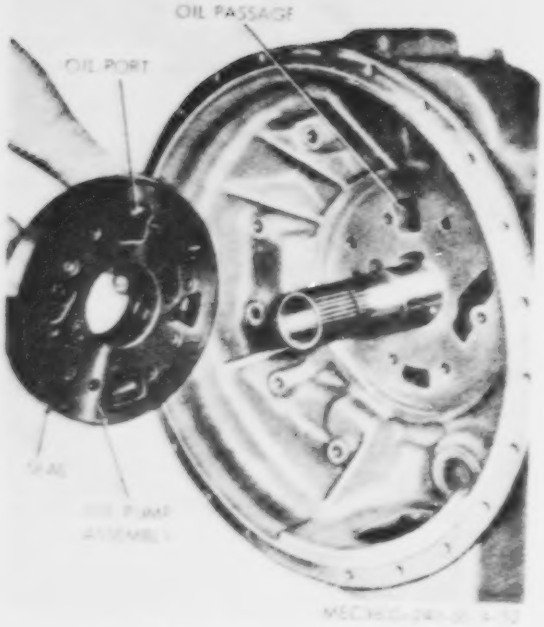

Figure 4-52. Charging oil pump assembly installation.

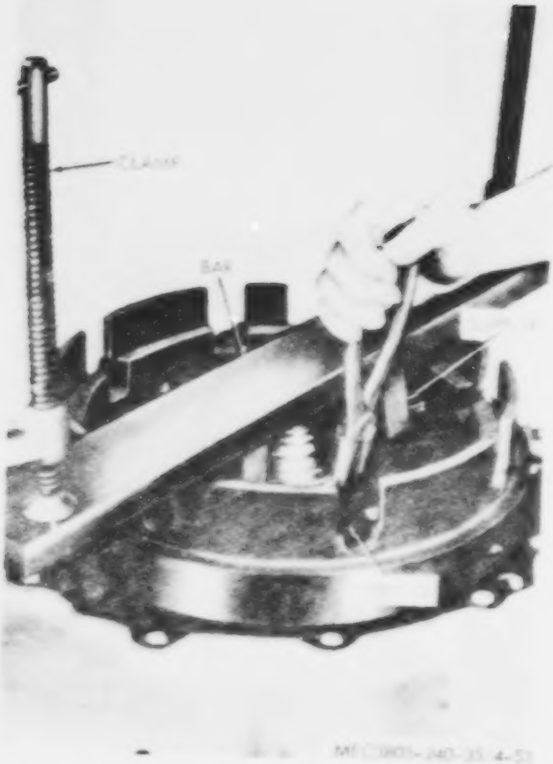

Figure 4-53. Splitter overdrive clutch piston spring snap ring installation.

(7) Place two supports on the piston return spring and lay a heavy bar across the supports. See figure 4-53. Attach two C-clamps to the converter housing to compress the spring (3, fig. 4-36) and install the snap ring (2).

(8) Grease and install the thrust washer (1) onto the hub of the converter ground sleeve (9, fig. 4-13). Install two hook-type seal rings (26) onto the converter ground sleeve and coat them with grease.

(9) Grease the seal rings on the turbine shaft. See figure 4-54. Attach a lifting sling to the converter housing. Lower the converter housing onto the transmission housing, indexing the slots in the splitter overdrive piston housing with the external tangs on the clutch plates. Aline the PTO opening in the converter housing with the top of the transmission housing.

(10) Secure the converter housing (23, fig. 4-13) with eight 1/2-13 x 2 1/4-inch bolts (3), six 1/2-13 x 4 1/2-inch bolts (4) and fourteen flat washers (5).

(11) Install two 1/2-13 x 2 1/4-inch bolts (16, fig. 4-16) and two lock washers (17) into the outside of the converter housing. Torque all converter housing bolts to 67 to 80 pound feet.

d. Installation of PTO Gear (fig. 4-13), Scavenge Pump (fig. 4-33) and Converter Elements (fig. 4-28).

(1) Install engine-driven PTO idler gear (20, fig. 4-13) with one 1/2-13 self-locking bolt (15) through the spindle (17). Install the scavenge oil pump with three bolts (1, fig. 4-33) and lock washers (2).

(2) Grease and install the hook-type seal ring (26, fig. 4-28) on the converter pump hub smaller end, and install the hub (23) using two 3/8-24 lifting bolts in the threaded holes. Aline the slots in the pump hub with tangs in the input driven charging oil pump. See figure 4-55. Remove the lifting bolts.

(3) Install the power take-off drive gear (24, fig. 4-28) on the hub (23).

(4) Install the splined spacer (18) and snap ring (17) onto the converter ground sleeve.

(5) Install a headless guide bolt into the converter pump hub and install the pump onto the pump hub (fig. 4-56).

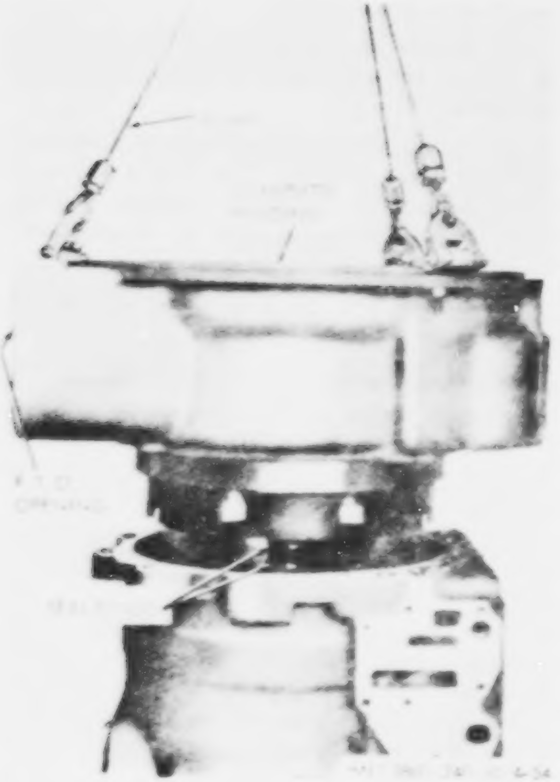

Figure 4-54. Converter housing assembly installation.

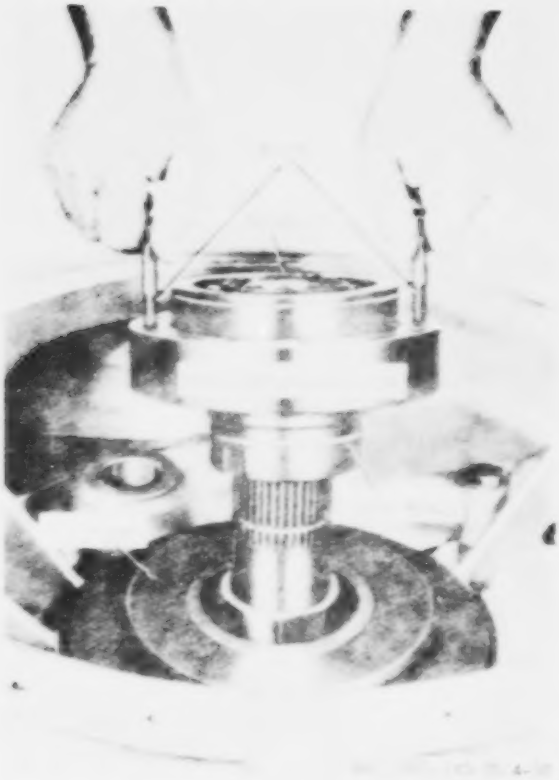

Figure 4-55. Converter pump hub and bearing installation.

(6) Install the two bearing retainers (21, fig. 4-28) into the groove of the pump hub bearing (25), alining the bolt holes. Install six lock plates (20) and twelve bolts (19) to retain the pump bearing. Torque the bolts to 33 to 40 pound feet. Bend one lock strip corner against each bolt head.

(7) Place the stator assembly (11) on the work bench in the position shown in figure 4-57 and install thrust bearing race (16, fig. 4-28) and thrust bearing (15), into the inside of the stator (11).

(8) Coat the pockets of the stator (11), the stator springs (14) and the stator rollers (13) with oil-soluble grease and install ten springs and ten rollers into the stator (fig. 4-57). The spring goes into the deep end of the cam pocket with the end of the spring that contacts the roller facing the center of the stator (fig. 4-58).

(9) Install the roller race (12, fig. 4-28) into the stator (11) with the stepped shoulder of the race against the needle thrust bearing (15).

(10) Install as a unit the stator and roller race assembly with the race downward. Hold the race in place with fingers to prevent it from falling out. Check the operation of the stator. It should rotate in a clockwise direction and lock up against rotation in a counterclockwise direction.

e. Installation of Lockup Clutch (fig. 4-28) and Flywheel (fig. 4-45).

(1) Lay the flywheel (10, fig. 4-45) on the assembly table with the cavity upward, and install the seal ring (10, fig. 4-28) on the hub.

(2) Install the seal ring (9) on the outside diameter of the lockup piston (8) and grease both seal rings.

(3) Place a pencil mark on the edge of the lockup clutch piston (8) opposite a dowel pin hole. Also place a pencil mark on the inside edge of the flywheel opposite a dowel pin.

(4) Install the lockup clutch piston (8) into the flywheel, alining the pencil marks to engage the recesses in the piston with the dowel pins.

(5) Install the lock key (7) in the lock key groove of the flywheel. Use oil-soluble grease to retain it.

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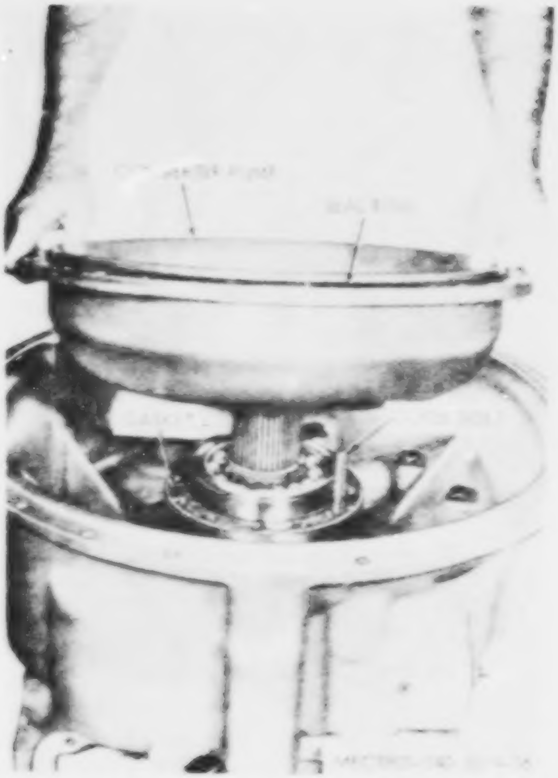


Figure 4-56. Converter pump assembly installation.

(6) Install the bearing (4) onto the hub of the turbine (3) and install the bearing and turbine over the turbine shaft in the front of the torque converter housing.

(7) Install the lockup clutch back plate (5) and the lockup clutch apply plate (6) onto the turbine. Dip the clutch plate in transmission oil before installing it.

(8) Install a headless guide bolt into the converter pump (22). Attach a lifting sling to the flywheel assembly and lower it to the position shown in figure 4-59.

(9) Place pencil marks on the edge of the flywheel to indicate the position of the lock key. Aline the index marks on the flywheel with the lock key groove in the lockup clutch back plate and lower the flywheel into position (fig. 4-59).

(10) Secure the flywheel (10, fig. 4-45) to the converter pump (22, fig. 4-28) with thirty self-locking bolts (1) and flat washers (2). Install the bolts through the top (engine driven) power takeoff opening and block the converter pump so that it will not rotate. Torque the bolts to 33 to 40 pound feet.

f. Installation of Intermediate-Range (fig. 4-24) Clutch and Gearing.

(1) Attach the lifting sling to two mounting holes (fig. 4-60) and lower the transmission onto wood blocks.

(2) Attach the lifting sling to the rear split line of the main housing (fig. 4-61) and raise the transmission to a rear-up vertical position, resting the converter housing on wood blocks (fig. 4-62).

Caution: **Transmission must not rest on the flywheel.**

(3) Using snap ring pliers, remove the snap ring (1, fig. 4-22) that retains the low- and intermediate-range sun gears. Remove the low-range sun gear (2), the intermediate-range sun gear (4), and bearing (3).

(4) Install the oil baffle (11, fig. 4-24) in the transmission housing against the high-range clutch assembly with the angle surface inside diameter down (toward the converter end). Install the intermediate-range clutch reaction housing (4) aligning the center slot (of the three closely spaced slots) with the anchor bolt hole in the transmission housing.

(5) Install the intermediate-range clutch anchor bolt (35, fig. 4-16) into the bottom of the transmission housing.

(6) Beginning with an internal-splined clutch plate, install one internal-splined (2, fig. 4-24) and one external-tanged (3) intermediate-range clutch plate. Dip the plates in oil before installing them.

(7) Install the intermediate-range ring gear (8) with the welded ring down.

(8) Install two additional internal-splined clutch plates (2) with one external-tanged plate (3) between them. Install the clutch apply plate (1) with the flat side down. Install the intermediate-range clutch piston return spring (7) with convex side up (spring inside diameter angle up).

(9) Install the outer (9) and inner (10) seal rings on the intermediate-range clutch piston housing (5). Install the intermediate-range clutch piston (6) and piston housing (5) (piston downward), alining the bolt hole with the hole in the transmission housing (fig. 4-63). Install one bolt (44, fig. 4-16), flat washer and lock washer into the piston housing. Torque the bolt to 26 to 32 pound feet.

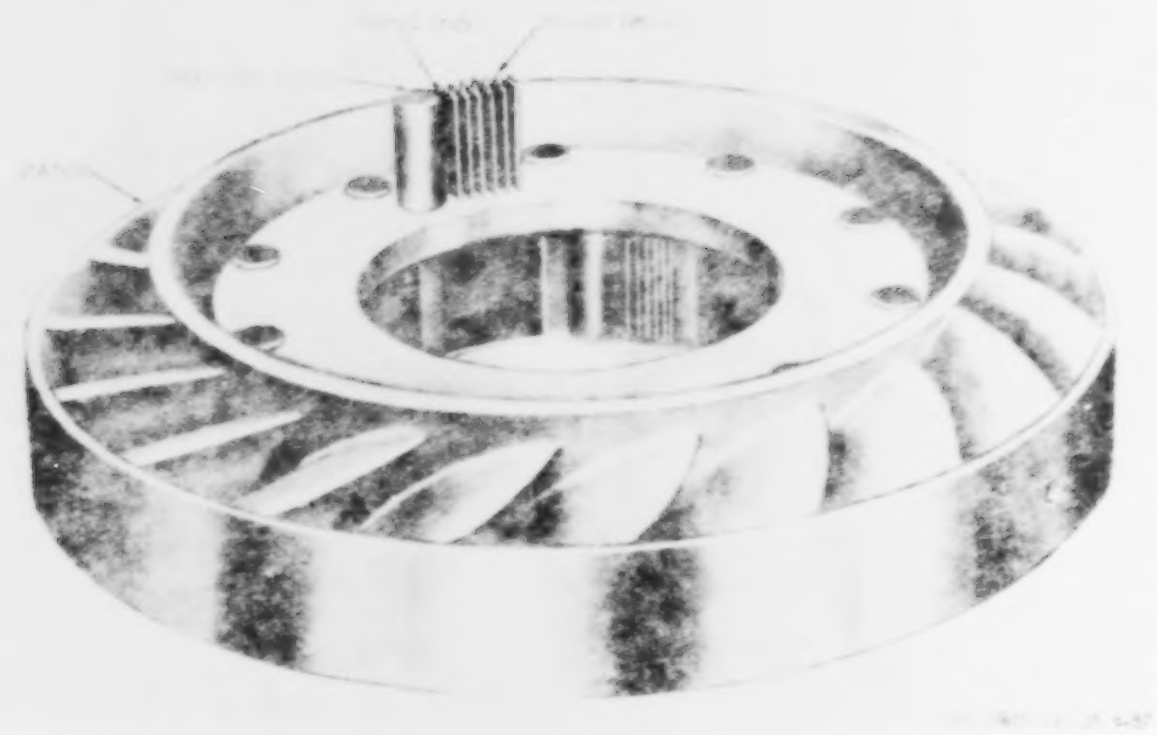


Figure 4-57. Converter stator, rollers, springs.

(10) Install the low-range clutch reaction housing (18, fig. 4-19), alining the center slot (of the three closely spaced slots) with the anchor bolt hole in the transmission housing. Aline the internal-splined high-range clutch plates (15, fig. 4-40).

(11) Install the low-range clutch reaction housing anchor bolt (38, fig. 4-16) through the transmission housing.

(12) Install intermediate-range planetary carrier assembly (12, fig. 4-22) into ring gear (24) and retain it with snap ring (5).

(13) Install the intermediate-range carrier (12) and low-range ring gear (24) into the transmission as an assembly.

Note. The external splines on the front of the carrier must engage four high-range clutch, internal-splined plates. Engagement is indicated when the top (rear) of low-range ring gear is approximately the same height as the top (rear) of the low-range clutch reaction housing.

(14) Install the intermediate-range sun gear (4) and bearing (3) onto the shaft with the bearing up.

g. Installation of Low-Range Clutch and Gearing (fig. 4-19).

(1) Install the low-range sun gear (2, fig. 4-22) and secure it with the snap ring (1).

(2) Beginning with an internal-splined clutch disk (16, fig. 4-19), alternately install two internal-splined (16) and one external-tanged (17) low-range clutch disks. Dip the disks in transmission oil before installing them.

(3) Install the low-range clutch apply plate (15) with the flat surface down. Lower the low-range planetary carrier assembly (19, fig. 4-22) into the transmission with the hub up. Aline the low-range pinions (15) with the low-range ring gear (24). Install the thrust washer (23) on the hub of the carrier.

(4) Install the reverse-range sun gear (22) with the sun gear up (fig. 4-64).

(5) Using a wire hook, pry up on the low-range ring gear (24, fig. 4-22) and install the snap ring (20) that retains the sun gear. Install the thrust washer (21). See figure 4-64.

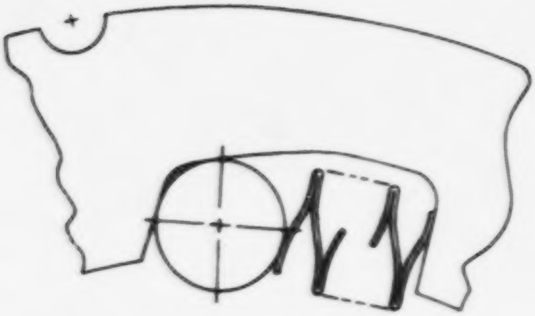


Figure 4-58. Stator cam spring and roller installation.

(6) Install the low-range piston return spring (14, fig. 4-19) with the convex side up (spring angle at inside diameter facing up).

(7) Install seal ring (13) onto low-range piston housing (9) hub. Install seal ring (10) into the groove in the outside diameter of low-range piston (11). Coat both seals with grease and install the piston, flat side first, into the low-range front side of piston housing (9).

(8) Install seal ring (12) onto the reverse-range hub of the piston housing (9). See figure 4-65.

(9) Attach a lifting sling to the reverse-range side of the low-and reverse-range piston housing and lower it into the transmission housing (fig. 4-65). As the piston housing is lowered, support the low-range piston (11, fig. 4-19) to prevent it from dropping out of the piston housing. Aline the bolt holes.

(10) Install one 3/8-16 x 2 1/4-inch bolt (37, fig. 4-16), flat washer (49) and lock washer (48) to retain the piston housing.

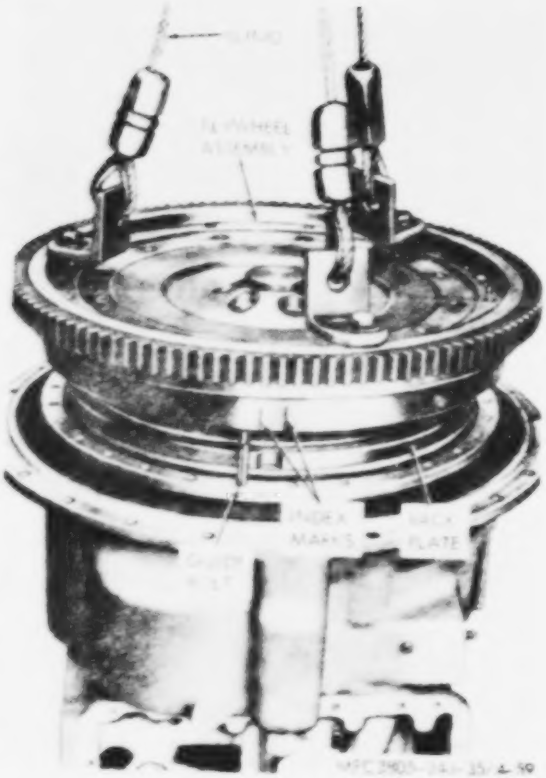


Figure 4-59. Flywheel assembly installation.

h. Installation of Reverse-Range Clutch and Gearing (figs. 4-19) and 4-17).

(1) Install seal ring (8, fig. 4-19) into the outside diameter groove of reverse-range piston (7). Grease both seals and install the piston, flat side first, into the rear of piston housing (9).

(2) Install the reverse-range piston return spring (6) with the concave side up (spring angle at inside diameter, facing down toward piston).

(3) Install the reverse-range clutch reaction housing anchor bolt (41, fig. 4-16).

(4) Lay the reverse-range clutch reaction housing (2, fig. 4-19) on the bench with its open end up. Dip the clutch disks (3 and 4) in oil and install an internal-splined disk (3) in the housing, an external-tanged disk (4), the reverse-range ring gear (1) (long external splines first), a second internal-splined disk (3) and the clutch apply plate (5) with the flat side against the clutch disks. See figure 4-66.

(5) Grip the assembled clutch pack, turn it over and install it into the housing, engaging the center slot (of three closely spaced slots) over the anchor bolt head. See figure 4-67.

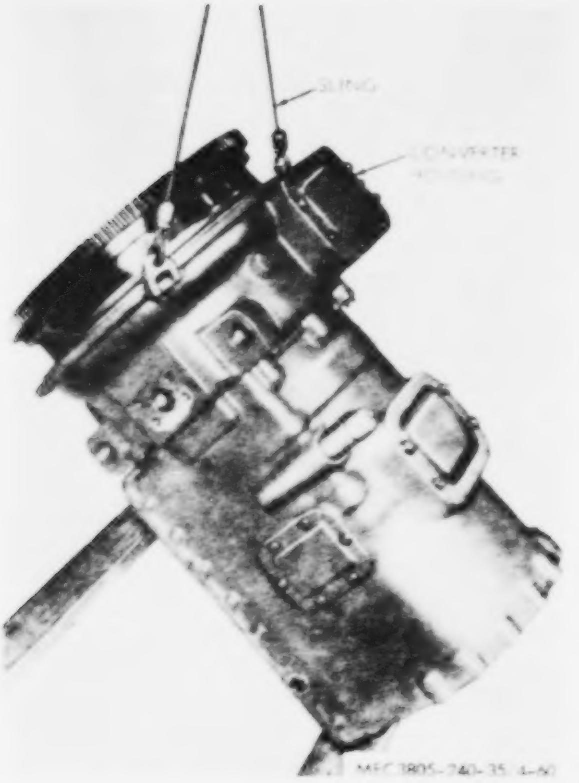


Figure 4-60. Positioning transmission horizontally on blocks.

i. Installation of Rear Cover and Output Shaft (fig. 4-8).

(1) Install the rear cover (28, fig. 4-8) onto main housing without a gasket, by installing four 1/2-13 x 1 3/4-inch bolts (26) at 90° intervals. Torque the bolts to 7 to 8 pound feet. See figure 4-68.

(2) Insert a feeler gage between the cover and housing at each of the four bolts. Average the four readings and select the proper gasket according to table 4-2.

(3) Remove the four bolts and the transmission rear cover from the transmision. Install the spacer (9, fig. 4-17) onto the transmission output shaft (10) and install the shaft into the transmission with the larger diameter splined (bushing) end down.

(4) Position cover (28, fig. 4-8) in a press, rear end upward. Install bearing (22) into cover (28).

Table 4-2. Transmission Rear Cover Gasket Thickness

Dimension	Gasket thickness	
0.005 to 0.015	use	0.012
0.016 to 0.021	use	0.016

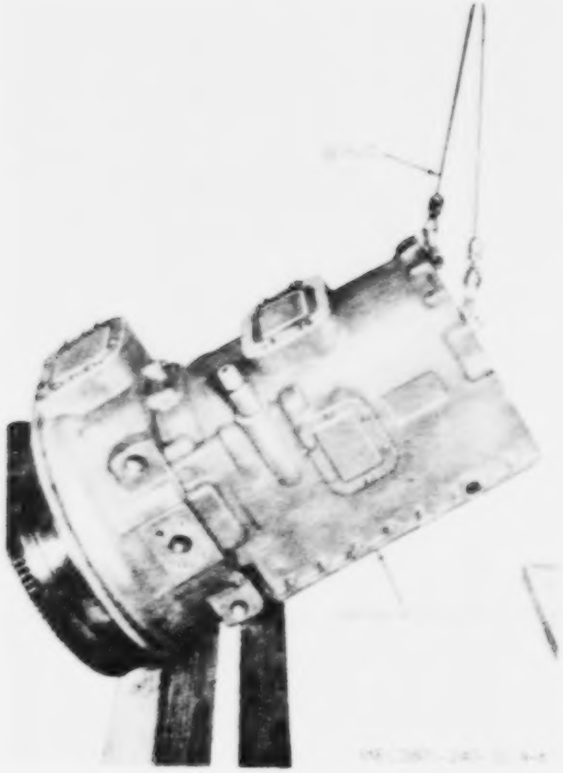


Figure 4-61. Lifting rear of transmission.

Table 4-2. Transmission Rear Cover Gasket Thickness—Continued

Dimension	Gasket thickness	
0.022 to 0.027	use	0.021
0.028 to 0.033	use	0.012 and 0.016
0.034	use	0.012 and 0.021

(5) Position carrier assembly (1 through 7, fig. 4-17) in a press long hub upward. Install the cover assembled in (4), above, onto the hub of the carrier. Press on the inner race of the bearing and seat it firmly on the carrier hub shoulder. Install snap ring (21, fig. 4-8) into the groove in the carrier hub.

(6) Install the rear cover gasket(s) (29) of proper thickness (see (2), above) and rear cover (28), using a headless guide bolt for alinement. See figure 4-69.

(7) Secure the cover with bolts (24 and 26) and lock washers (25 and 27). See figure 4-70. Torque the bolts to 67 to 80 pound feet.

(8) Apply compressed air (125 psi max) to each of the clutch apply holes to check the operation of each clutch (fig. 4-70).

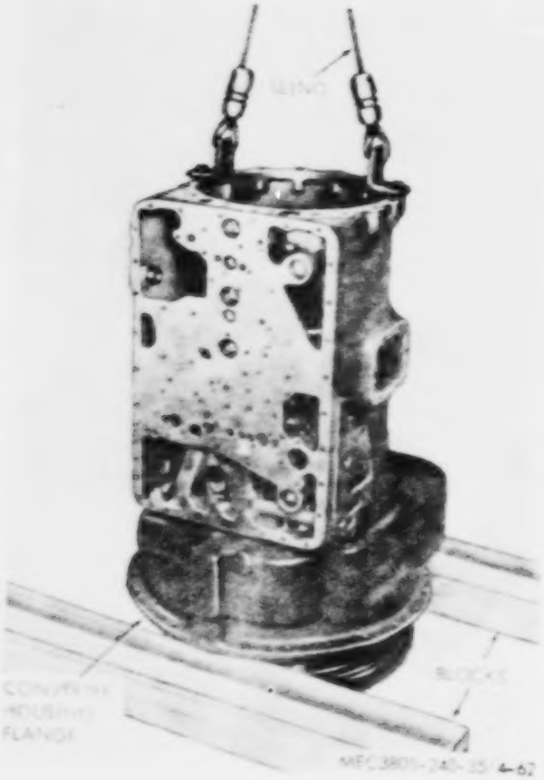


Figure 4-62. Positioning transmission upright on converter housing flange.

(9) Install the snap ring (20, fig. 4-8) (chamfered ID up) on the output shaft. It may be necessary to pull out (up) on the shaft to fully expose the snap ring groove.

(10) Install 5/8-18 self-locking nut (33, 36 and 39, fig. 4-16) and flat washer (34, 37 and 40, fig. 4-16) on each of reverse-, low- and intermediate-range reaction housing anchor bolts. See figure 4-71. Torque the nuts to 134 to 160 pound feet. Tighten the bolts between the nuts to 26 to 32 pound feet.

(11) Install the small (shorter) spacer (19, fig. 4-8), speedometer drive gear (18) and longer spacer (17) onto the output shaft (10, fig. 4-17).

(12) Heat the rear bearing (16, fig. 4-8) to 200° F for one hour. Coat the output shaft with white lead and install the bearing on the output shaft with the lettered end up. Tap on the inner race to seat the bearing.

(13) Install the rear-bearing retainer gasket (15).

(14) If rear oil seal (9) was removed, install a new seal. Coat the outer circumference with an approved non-hardening sealer and install it, spring-loaded lip first, into the rear bearing retainer (7). Press it in until it seats lightly on the shoulder in the retainer.

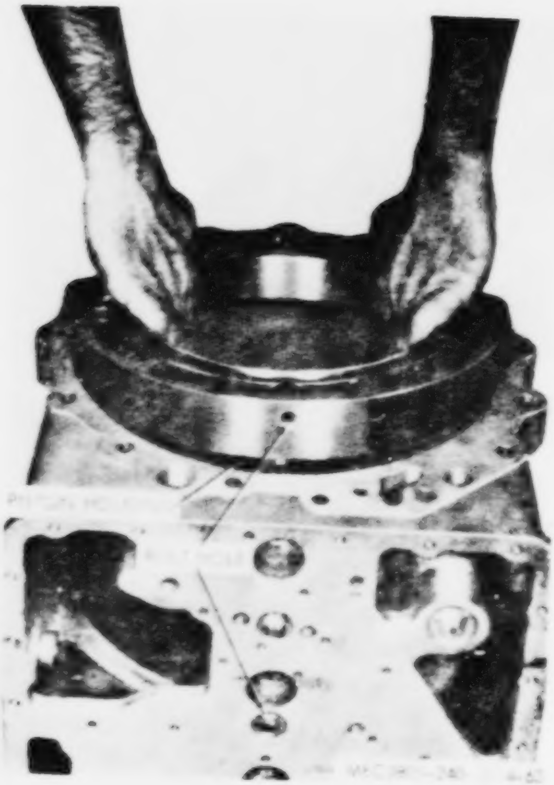


Figure 4-63. Intermediate-range clutch piston housing installation.

(15) If oil baffle (8) was removed, press it, flange first, into the retainer (7) until it is flush with, or slightly below, the rear surface of the bearing retainer.

(15) If the rear bearing (16) was heated for installation, let it cool for one hour. Install the rear bearing retainer (7), alining the bolt holes. Secure the retainer with seven 1/2-13 x 1 5/8-inch bolts (3), one 1/2-13 x 2 3/4-inch bolt (5) and eight lock washers (4 and 6). Torque the bolts to 67 to 80 pound feet.

(17) Install the sleeve bearing (14), gasket (13), outlet cover (12) with two bolts (10) and lockwashers (11). Torque the bolts to 17 to 20 pound feet.

j. Installation of Oil Transfer Plate and Valve Assemblies (figs. 4-12 and 4-14).

(1) Install the seal ring (24, fig. 4-16) onto the range selector shaft (23) and install it into the main housing. Install the snap ring (22). In-

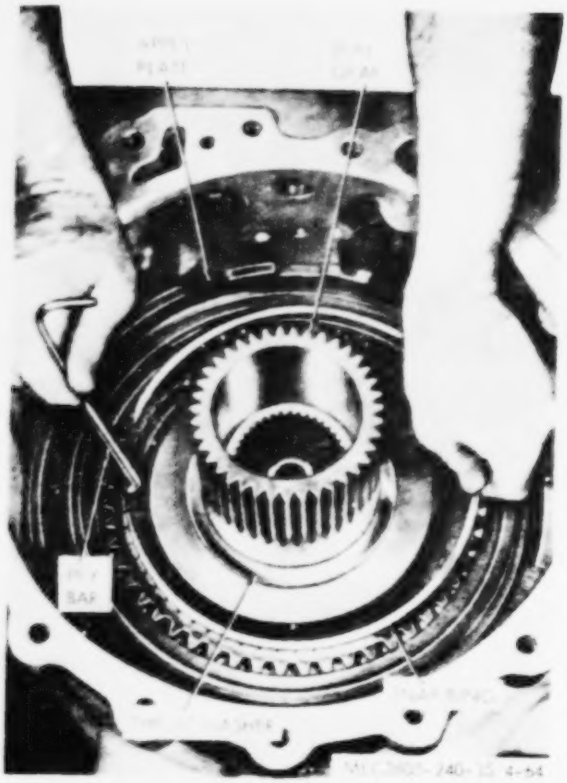


Figure 4–64. Reverse-range sun gear snap ring installation.

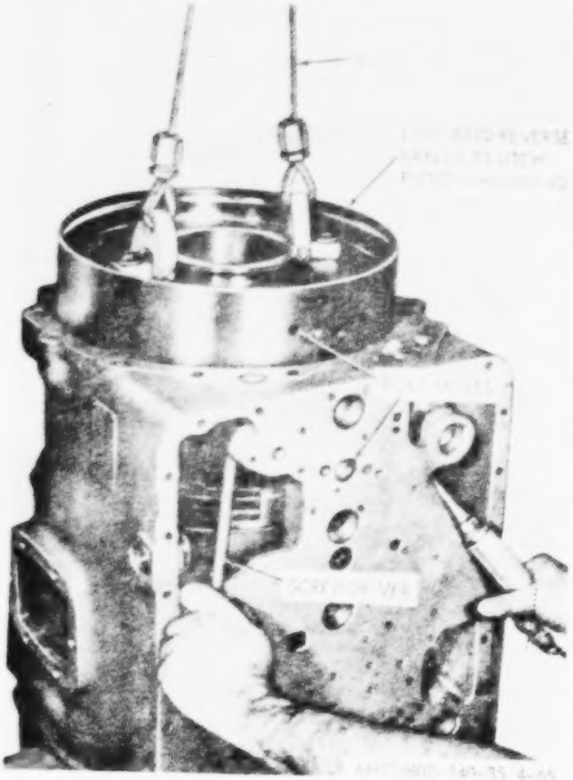


Figure 4–65. Low-and reverse-range clutch piston housing installation.

stall the external shift lever (21) in the same position as when removed. Tighten nut (18) on lockwasher (19) and bolt (20) to clamp the lever on the shaft.

(2) Install the oil transfer plate (9, fig. 4–14) and tube (49) as an assembly onto the bottom of the main housing, alining the bolt holes.

(3) Install twenty 1/4-20 bolts (5 and 7) and lock washers (6 and 8) in the oil transfer plate. Torque the bolts to 9 to 11 pound feet.

(4) Install converter pressure regulator valve assembly (11 through 28, fig. 4–12) onto the oil transfer plate and secure with six bolts (11) and lock washers (12). Torque the bolts to 9 to 11 pound feet.

(5) Install the control valve assembly (10 through 45, fig. 4–14) on the oil transfer plate, indexing the shift lever into the slot in the control valve. See figure 4–72.

(6) Install fifteen long (10) and one short (2) valve body retaining bolts with lock washers (3) and torque them to 4 to 6 pound feet.

k. Installation of Oil Pan (fig. 4–11), Oil Suction Tube, and Output Flange.

(1) Install the oil pan gasket (3, fig. 4–11) and oil pan (2) onto the bottom of the main housing. Install 29 self-locking bolts (1) and torque the bolts to 15 to 18 pound feet.

(2) Install the oil suction tube gasket (14, fig. 4–13), tube (13), tube seal ring (7, fig. 4–11) and seal compressor flange (6). Install four bolts (11, fig. 4–13) and lock washers (12) holding the tube (13) to the converter housing (23).

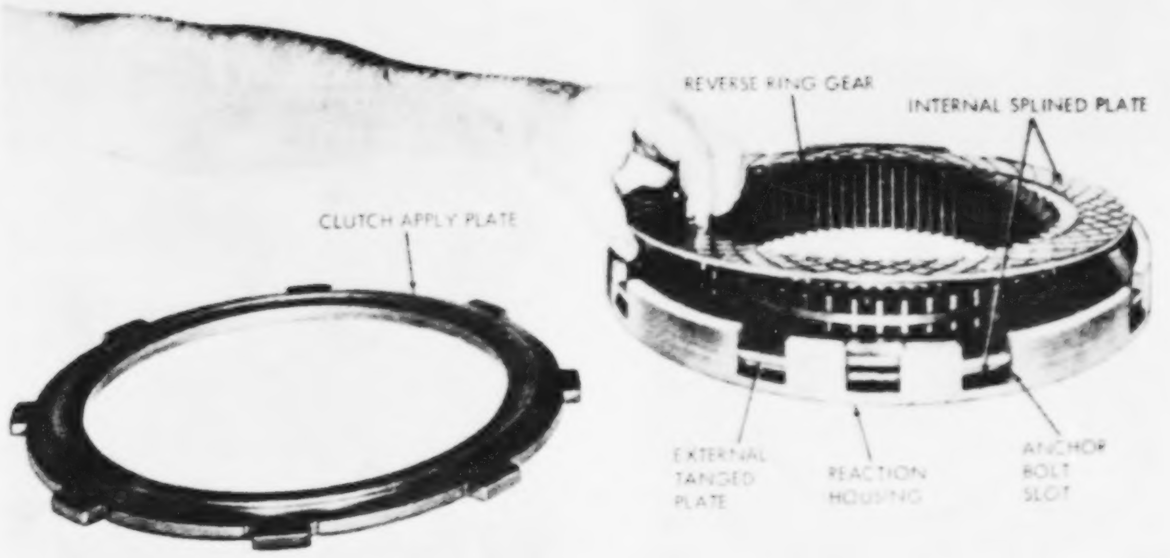
(3) Install two bolts (5, fig. 4–11) and nuts (4) anchoring the tube to the oil pan (2).

(4) Install the adapter body gasket (8, fig. 4–12) and adapter assembly (7) with five long (1), two medium (3) and one short (5) bolts and lock washers (2, 4 and 6).

(5) Install the oil screen (14, fig. 4–11) into the oil pan (2), with the closed end of the screen out. Install the cover seal ring (13), spring (12) and cover (11).

(6) Install the oil screen cover retainer strap (10), with one bolt (9) and square nut (8). Torque the bolt to 14 to 18 pound feet.

(7) Install the rear output flange (2, fig. 4–8) and flange nut (1). Tighten the nut to 700 to 1000 pound feet. Use two bolts in the flange


REVERSE RING GEAR
INTERNAL SPLINED PLATE
CLUTCH APPLY PLATE
EXTERNAL TANGED PLATE
REACTION HOUSING
ANCHOR BOLT SLOT

MEC 3805-240-35 4-66

Figure 4-66. Reverse-range clutch pack assembly.

and a pipe support to prevent output shaft from rotating. See figure 4-73.

4-49. Installation

Refer to paragraph 2-41 and install the transmission/torque converter assembly.

4-50. Testing

After installing the transmission/torque converter in the ditcher, pressure test the assembly to ensure that it is operating correctly. Refer to paragraph 4-27 for pressure testing instructions.

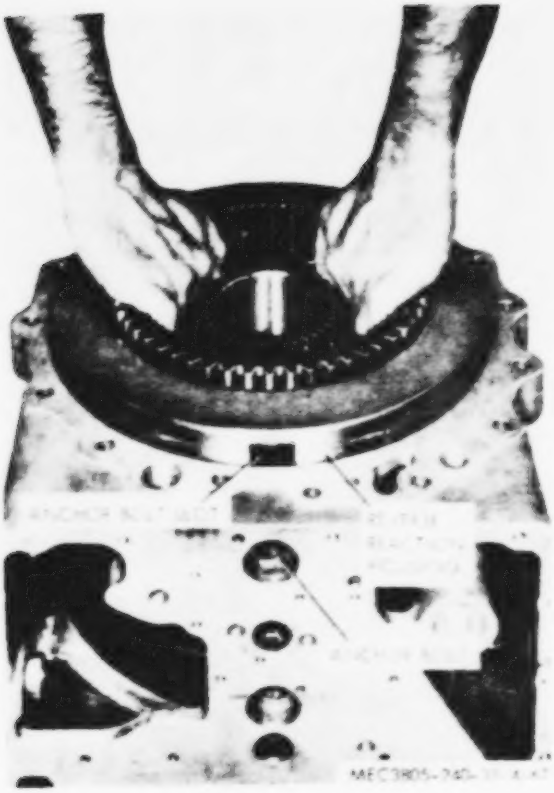

ANCHOR BOLT
REVERSE REACTION HOUSING
ANCHOR BOLT
MEC3805-240-35/4-67

Figure 4–67. Reverse-range clutch pack installation.

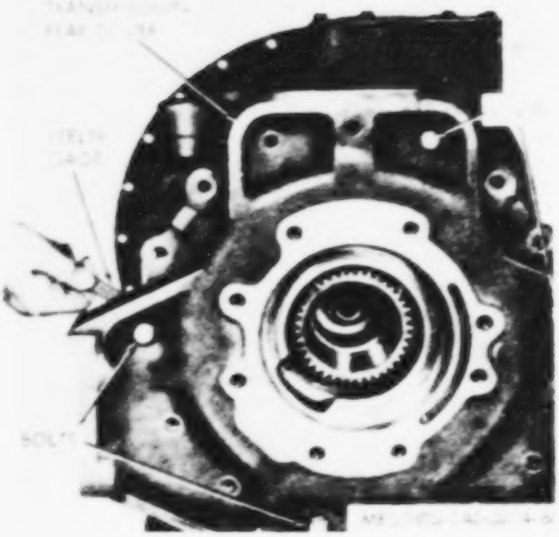

TRANSMISSION REAR COVER
FEELER GAGE
BOLTS

Figure 4–68. Rear cover gasket thickness determination.

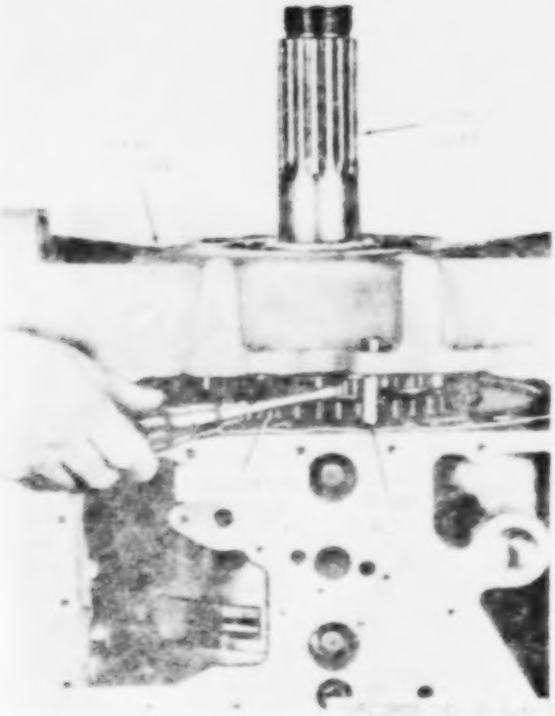


Figure 4-69. Rear cover and reverse-range planetary installation.

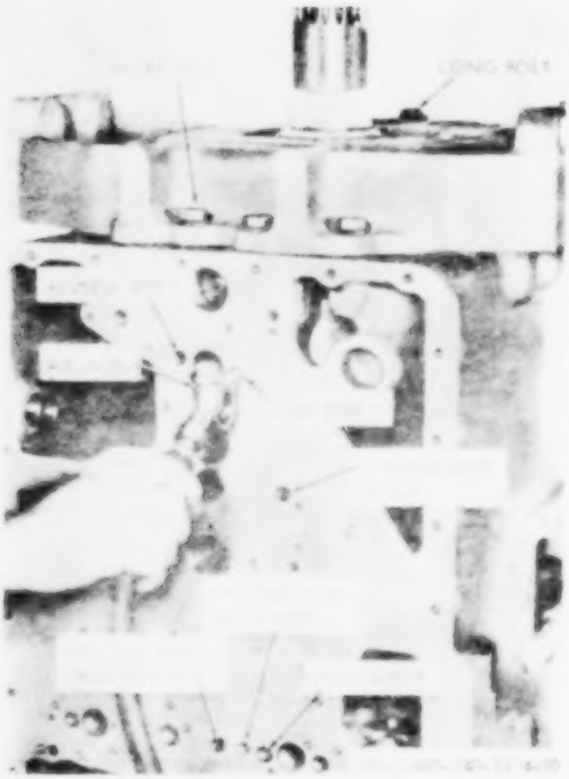


Figure 4-70. Clutch operation test points.

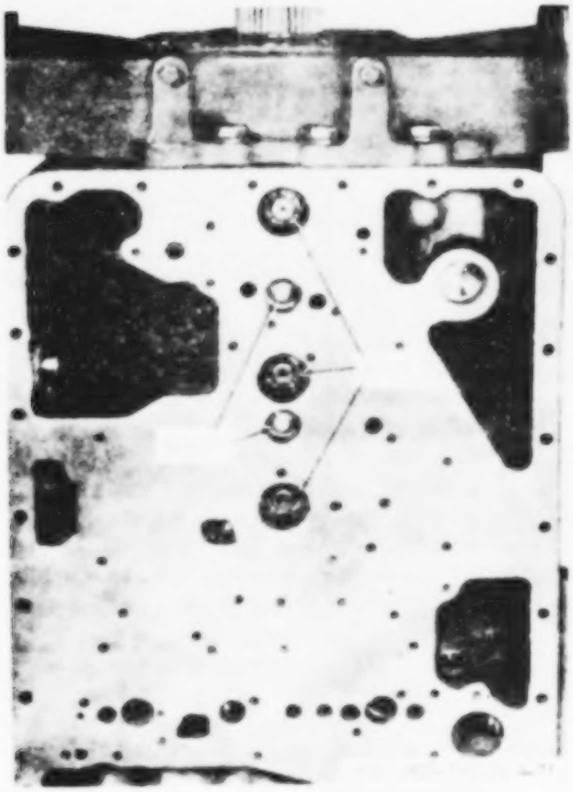


Figure 4-71. Clutch reaction housing and piston housing anchor bolts and nuts

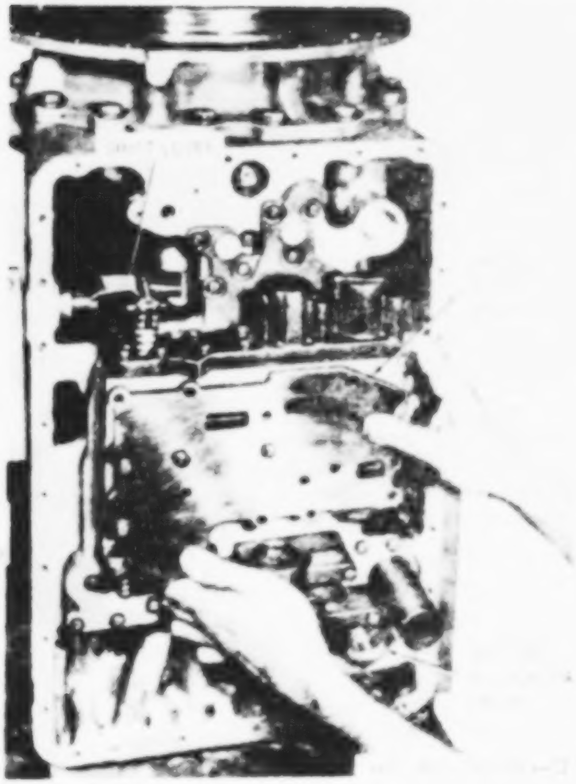


Figure 4-72. Control valve assembly installation.

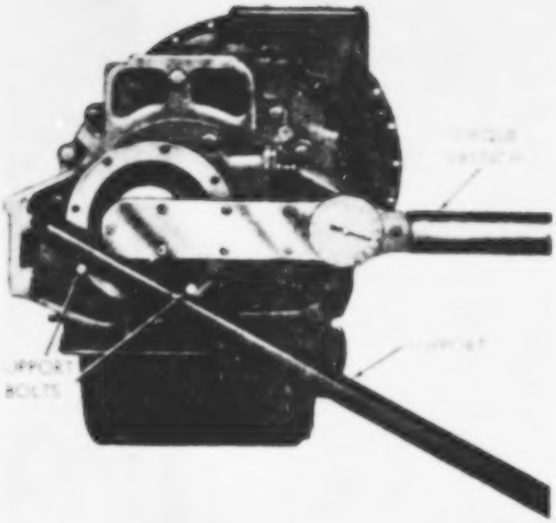

TORQUE
WRENCH
SUPPORT
UPPORT
BOLTS
ME 3805-240-35/4-73

Figure 4-73. Output flange nut installation.

CHAPTER 5

TRANSFER CASE ASSEMBLY REPAIR INSTRUCTIONS

Section I. GENERAL

5-1. Description

a. Location and Function. The transfer case (fig. 5-1) is located to the rear of the transmission, and is coupled to the transmission by a short propeller shaft. The transfer case contains five major shaft and gear assemblies (fig. 5-2). The function of the transfer case is to distribute engine power to propeller shafts which drive the front and rear axle assemblies and the right-angle sprocket drive assembly.

b. Operation. The transfer case contains a shifter shaft with forks which position sliding gears to operate the ditching machine in either of two modes. In road travel, the wheels are driven by mechanically transmitted engine torque, while the bucket line is inoperative. Crowd drive operation is used when digging. In this mode, the right-angle sprocket drive assembly is powered directly by mechanically transmitted engine torque. Torque to drive the wheels is transmitted hydraulically by the crowd drive motor (para 8-15; which receives fluid under pressure from the crowd drive pump (para 8-14).

c. Power Divider and Clutches. The output shaft (shaft 5) of the transfer case contains a power divider assembly—an in-line differential—which permits the front and rear axle shafts to rotate at different speeds. A hydraulic clutch pack, actuated at the operator's option, permits the power divider assembly to be locked up so that both shafts rotate at the same speed, providing superior wheel traction over rough terrain. The right-angle sprocket drive power take-off shaft (shaft 1) has a similar clutch pack which is designed to permit slipping at a certain torque to prevent bucket line damage in the event that an immovable object is encountered during digging operations.

d. Lubrication. A gear pump at the top of the transfer case assembly supplies lubricating oil through a manifold and piping to lubricate all transfer case bearings.

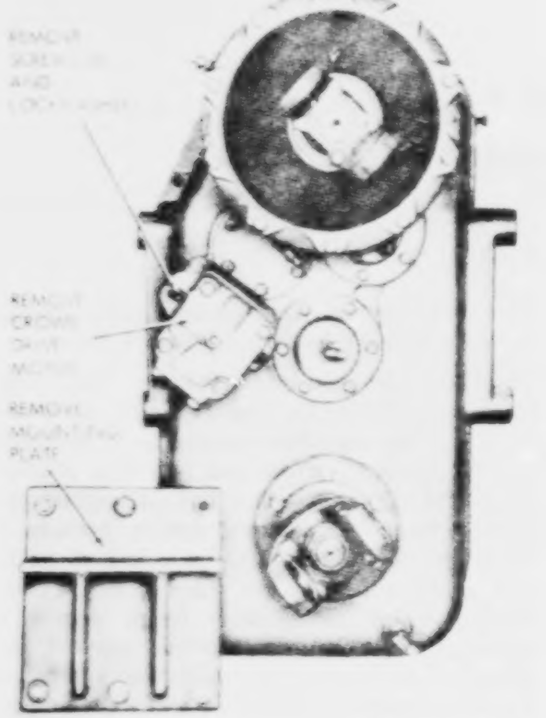
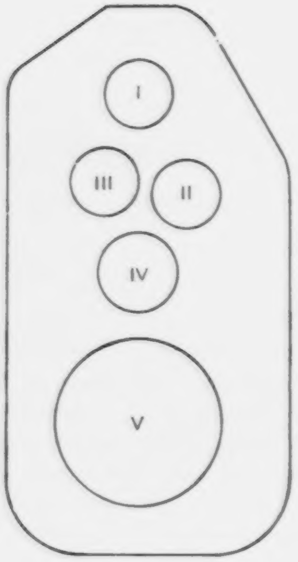


Figure 5-1. Dual range transfer case assembly, rear view.



MEC3805-240-35/5-2

Figure 5-2. Transfer case shaft and gear arrangement, front view.

Section II. LUBRICATION SYSTEM

5-2. Tubing Assembly and Related Parts

a. Removal and Disassembly.

(1) Refer to paragraph 2-42 and remove tubing assembly from transfer case.

***Caution:* Always remove tubing before transfer case is removed from ditching machine.**

(2) Disassemble tubing in the numerical order shown in figure 5-3.

b. Cleaning. Clean all tubes and related parts with an approved solvent and dry with compressed air.

c. Inspection and Repair.

(1) Inspect tubes (1 through 10) for cracks, pits, dents, and corrosion. Replace defective tubes.

(2) Inspect connectors (11, 13, 16), reducers (14) and elbows (12, 17, 19) for damaged threads. Replace defective parts.

(3) Clean the screen oil filter (20) with an approved solvent and inspect mesh for holes, clogging, and buckling. Replace a defective screen filter.

d. Reassembly and Installation.

(1) Reassemble the tubes and related parts in reverse of numerical sequence as indicated on figure 5-3.

(2) Refer to paragraph 2-42 and install the tubing assembly on the transfer case.

***Caution:* To avoid damaging the tubing assembly, do not install it on the transfer case until the case assembly has been installed in the ditching machine**

5-3. Lube oil pump, gear and gear housing assembly

a. Disassembly.

(1) Removal. Refer to paragraph 2-42 and remove the oil pump, gear and gear housing assembly from the transfer case.

***Caution:* Always remove these assemblies before the transfer case is removed from the**

ditching machine. Use care in breaking the plastic gasket between gear housing and transfer case.

(2) Disassemble the lube oil pump assembly, the gear, and the gear housing assembly in the numerical sequence as indicated on figure 5-4.

(*a*) Remove pressure relief fitting (3).

(*b*) Remove four screws (4) and lockwashers (5) from pump to housing.

(*c*) Turn the pump gear until the set screw (10) on the hub becomes visible. Loosen the screw.

(*d*) Insert a punch or drift through the relief-fitting hole until it contacts the pump shaft in the center of the gear. Strike the drift and drive the shaft out of the gear (13). Remove key (14) from gear.

Caution: **Before disassembly plug the pump ports with rubber or plastic stoppers and wash the exterior of the pump with approved cleaning solution.**

(*e*) Disassemble the lube oil pump assembly in the numerical sequence as indicated on figure 5-5.

Caution: **Before disassembling pump, scribe a line on the body and cover. Cover must be replaced in original position or a blown seal will result.**

b. Cleaning. Clean all parts with an approved solvent and dry with compressed air.

c. Inspection and Repair.

(1) Inspect needle bearings (7, 19) for spalls and case failure. Be sure shaft bearing does not contact shell. Check to see that needles are held securely. Replace defective bearings.

(2) Inspect shaft seals (2, 8) for nicks, cuts, ridges, wear and loss of pliability. Replace defective seals.

(3) Inspect seal plate (2) for distortion. Replace a defective plate.

(4) Inspect drive shafts (13, 16) for wear and roughness. Replace defective shafts.

(5) Inspect gears (12, 15) for burrs, scoring, gouging and pickup. Inspect bearing surfaces for scoring, spalling, flaking and other evidence of potential failure. Face of gear should be sharp and square with gear teeth. Replace defective gears.

Caution: **Always replace these gears in sets.**

(6) Inspect wear plate (17) for scoring and gouging. Be sure plate is flat and parallel. Replace a defective plate.

(7) Replace preformed packing.

(8) Inspect pump body (20) and cover (6) for nicks, scratches and cracks. Replace defective units. Inspect gear housing for cracks. Replace a defective housing.

(9) Test pressure relief fitting (3, fig. 5-4) for 1-5 psi of pressure. Replace a defective fitting.

d. Reassembly.

(1) Reassemble the lube oil pump in reverse of numerical sequence as indicated in figure 5-5.

Note. Install the wear plate seal assembly (17) in proper location, with bronze toward gear. To aid installation of wear plate in the engaging side of the cover, insert a long, thin strip of metal under the wear plate assembly on the left side and extend it to the outside of the pump body (20). Install the dowel pins (11). Install body. Press body and cover together and withdraw strip.

(2) Reassemble the gear and gear housing assembly in reverse of the numerical order indicated in figure 5-5.

(3) Lightly grease bearings (7, 19) and all inner surfaces.

(4) Torque pump body and cover capscrews to 230 in-lbs. (19 ft-lbs.).

Note. Install the wear plate seal assembly (17) there is no interference between the wear plate and seal assembly. Any extension must be removed. Secure preformed packing and seals with an approved grease. Turn gears sufficiently to remove foreign particles before torquing up the assembled pump.

(5) Lubricate pump well with approved grease and break it in slowly. Apply 200 psi of pressure to force wear plates away from gears for initial lubrication.

(6) Refer to paragraph 2-42 and install the lube oil pump, gear and gear cover assembly on the transfer case assembly.

Note. Do not install lube oil pump, gear, or gear housing until transfer case has been installed in ditching machine. Apply a thin coating of plastic gasket to lube oil pump flange and gear housing before installation.

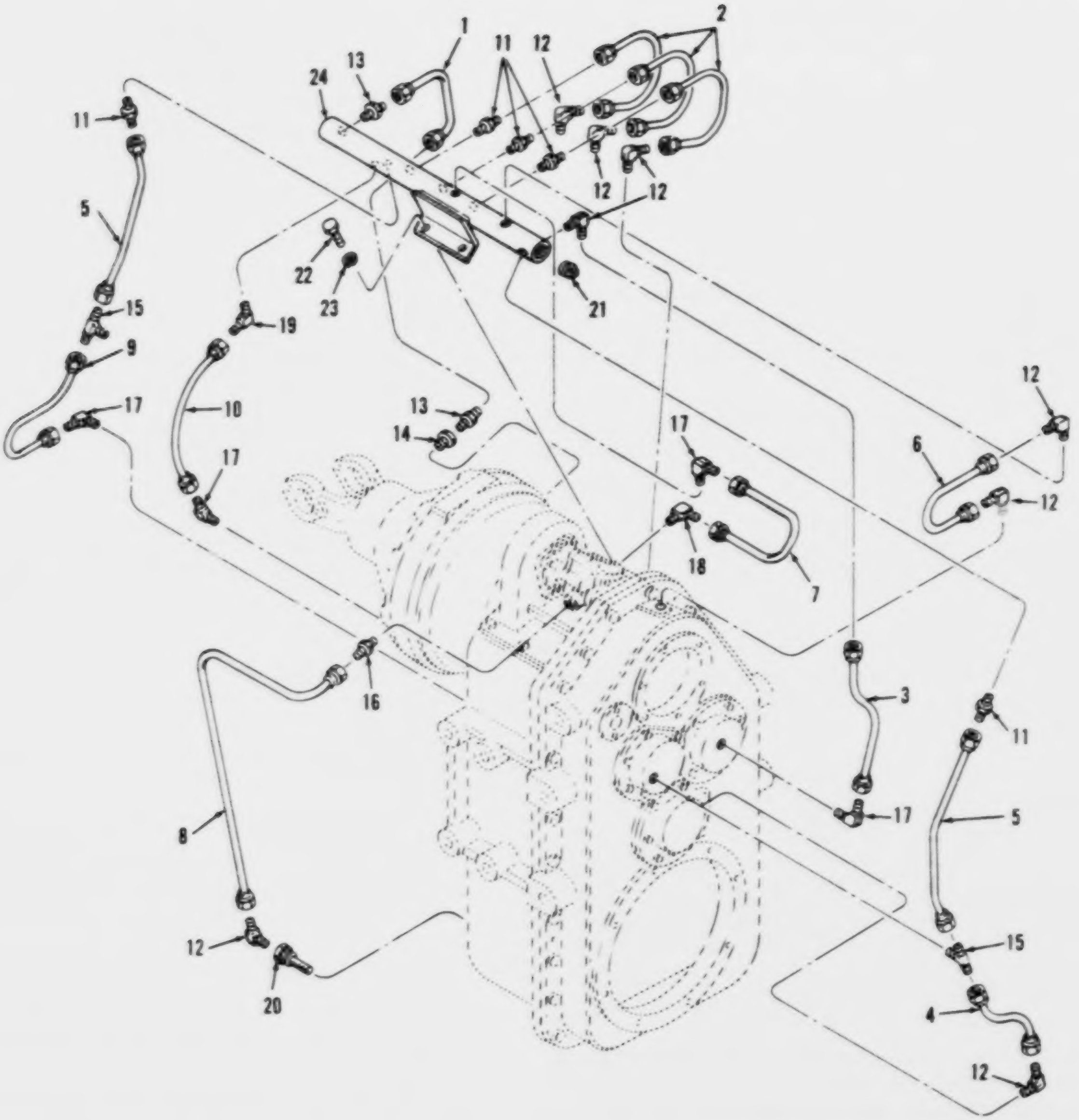

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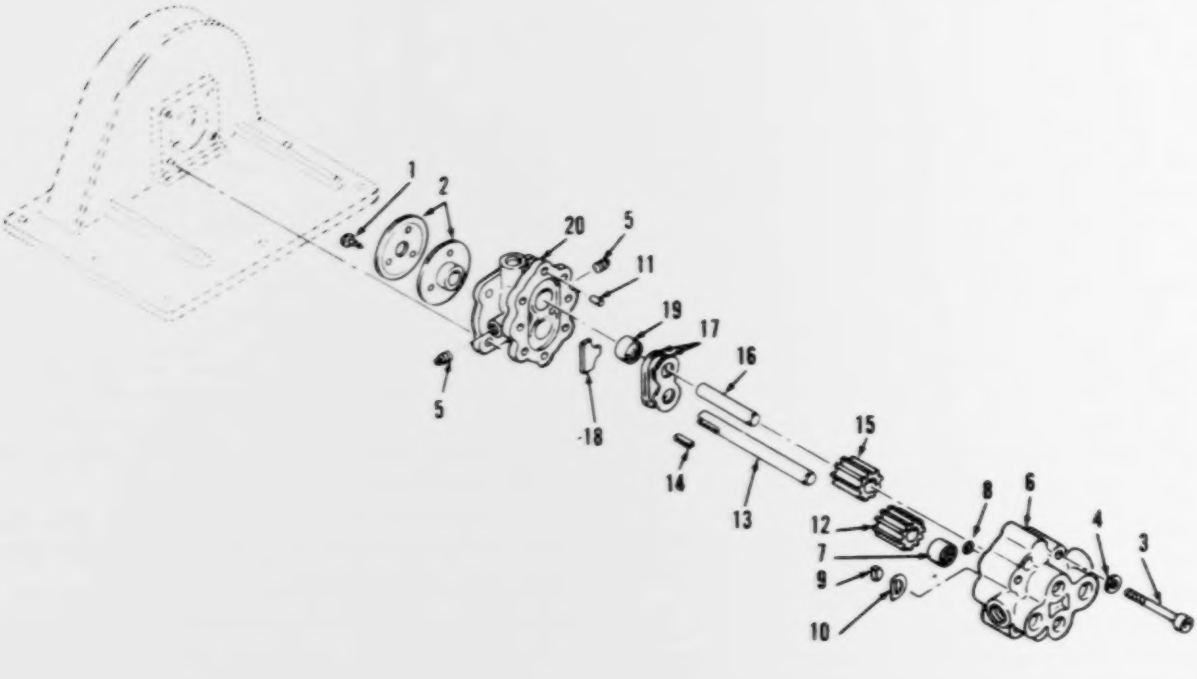
Figure 5-3. Tubing assembly and related parts, exploded view.

1 Tube assembly
2 Tube assembly (3 rqr)
3 Tube assembly
4 Tube assembly
5 Tube assembly (2 rqr)
6 Tube assembly
7 Tube assembly
8 Tube assembly
9 Tube assembly
10 Tube assembly
11 Connector, male, 1/8 in. NPT (5 rqr)
12 Elbow, male, 1/8 in. NPT (8 rqr)
13 Connector, 1/4 in. NPT (2 rqr)
14 Reducer, male, 1/4 in. NPT, female, 1/8 in. NPT
15 Tee, male, 1/4 in. NPT (2 rqr)
16 Connector, male, 1/2 in. NPT
17 Elbow, 90°, 1/4 in. NPT (4 rqr)
18 Elbow, male, 90°, 3/8 in. NPT
19 Elbow, 3/8 in. NPT
20 Screen, oil filter
21 Plug, pipe, 3/4 in. (2 rqr)
22 Screw, 3/8 -16 x 1 in. (2 rqr)
23 Washer, lock, 3/8 in. (2 rqr)
24 Pipe, junction

Figure 5-3—Continued

Figure 5-4. Transfer case and subassemblies, exploded view.

(Located in back of manual)



1 Screw, tap, threaded, cutting, 9/32 x 1/4 in. (3 rqr)
2 Plate, seal
3 Screw, cap, socket head, 5/16-18 x 2 1/2 in. (4 rqr)
4 Washer, flat, 5/16 in. (4 rqr)
5 Cap, plain, protective, dust and moisture seal (2 rqr)
6 Cover
7 Bearing, roller, needle (2 rqr)
8 Packing, preformed
9 Insert, budging
10 Insert, gasket
11 Pin, grooved head (2 rqr)
12 Gear, spur
13 Shaft, straight drive
14 Key, machine
15 Gear, spur
16 Shaft, straight idler
17 Wear plate and seal assembly
18 Block, anti-extension
19 Bearing, roller, needle (2 rqr)
20 Body and plug assembly

Figure 5-5. Transfer case lube oil pump, exploded view.

Section III. TRANSFER CASE ASSEMBLY

5-4. Transfer Case Assembly Removal

Caution: **Before removing the transfer case from the ditching machine, clean assembly with an approved solvent and remove lube oil tubing and pump assemblies to prevent damage. Plug all openings, using plastic plugs.**

Refer to paragraph 2-42 and remove the transfer case assembly from the ditching machine. Refer to paragraph 2-48 and remove the crowd drive motor from the transfer case housing.

5-5. Yoke, Bearing Retainer Assembly, and Rear Output Shaft V-Assembly

a. General. The yoke, bearing retainer assembly, and rear output shaft V assembly transmit torque from the transfer case to the rear axles.

b. Removal and Disassembly.

(1) Remove the bearing retainer capscrews and lockwashers and remove the yoke, bearing retainer and shaft V assembly as illustrated in figures 5-4 and 5-6.

Note. Benchmark all bearing caps and housings. Clean all plastic gasket material from separated parts.

(2) Disassemble yoke, bearing retainer and output shaft V-assembly in the numerical sequence illustrated on figure 5-7.

c. Cleaning. Clean all parts with approved cleaning solvent and dry with compressed air.

d. Inspection and Repair.

(1) Inspect splines on shafts (7) for cracks, wear, chipping, and distortion. Remove burrs with a hone. Replace a defective shaft.

(2) Inspect yoke (3) for cracks, bending, wear and chipping. Remove burrs from spline. Replace a worn or cracked yoke.

(3) Discard used shims (29, 30, fig. 5-4) and replace with new ones.

(4) Inspect bearing retainer (4, fig. 5-7) for cracks, wear, roughness and burrs. Inspect flange surfaces for gouges. If possible, remove defects with a stone hone. Retap threaded holes. Replace a defective retainer.

(5) Replace oil seal (6). Soak new oil seal in lubricating oil for 45 minutes before installation.

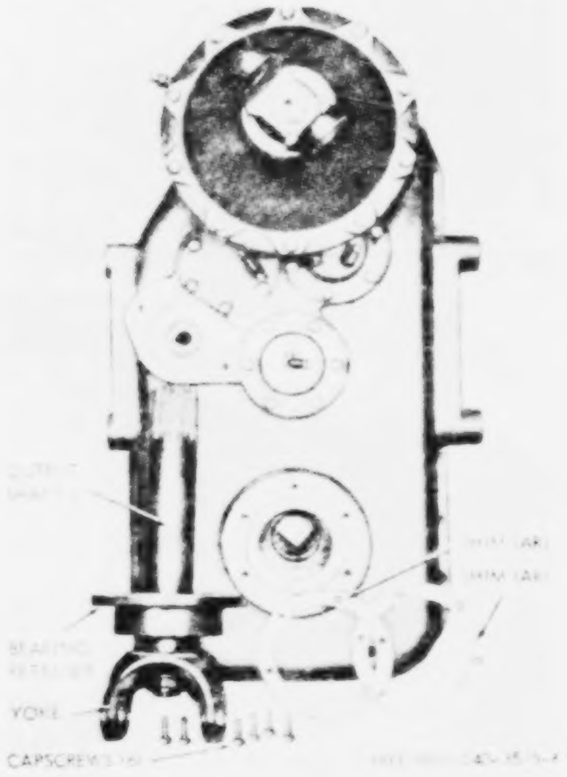


Figure 5-6. Yoke, bearing retainer and rear output shaft V, removal and installation.

(6) Inspect balls and bearing races for roughness, spalling, pitting, galling and wear. Hold bearing in hand and turn race slowly. Listen for noisy or rough operation. Replace noisy or unevenly operating bearings.

Caution: **Do not spin bearings. For further information on proper handling of bearings, refer to TM 9-214.**

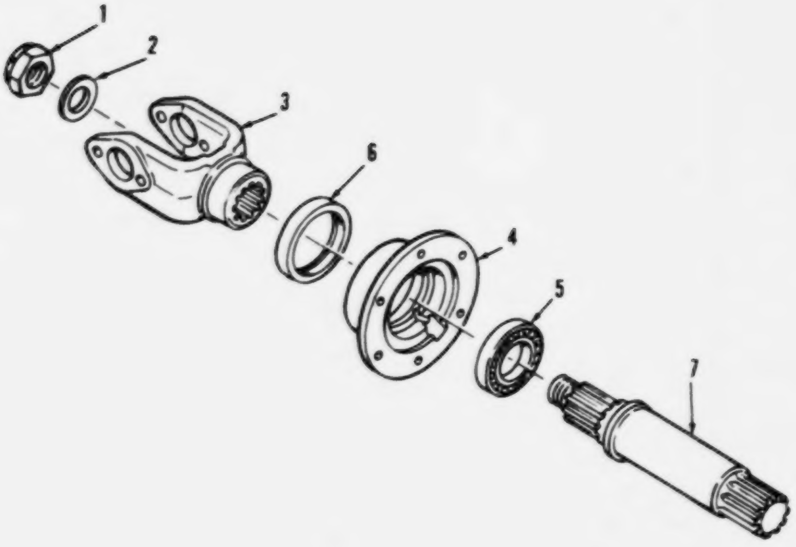
e. Reassembly and Installation.

(1) Dip shaft and bearings in light, clean lubricating oil.

(2) Reassemble yoke, bearing retainer assembly and output shaft assembly V in reverse of numerical sequence as illustrated on figure 5-7.

(3) Install yoke, bearing retainer assembly, and output shaft V assembly in reverse of the numerical sequence as illustrated on figure 5-4.

Note. Fit shims to allow .003—.007 end play. Measure end play with feeler gauge between bearing retainer and transfer case housing with capscrews torqued to 13-17 ft-lbs. When proper play is achieved, disassemble and apply plastic gasket to flange surface of bearing retainer and shims and to washer and flange side next to yoke. Then reassemble torque and capscrews to 13-17 ft-lbs.



MEC3805-240-35/5-7

1	Nut, 1 1/2-12 in.
2	Washer
3	Yoke, rear output
*4	Retainer, bearing
*5	Bearing, ball
*6	Seal, oil
*7	Shaft, output, V

*Oil seal and ball bearing to be removed from bearing retainer after removal of bearing retainer assembly.

Figure 5-7. Rear output shaft V, yoke and bearing retainer assemblies, exploded view.

5-6. Rear Bearing Cap Assembly, Shaft IV

a. General. This assembly retains the bearing, controls the end play of the shaft, and returns oil to the lube oil pump.

b. Removal and Disassembly.

(1) Benchmark the bearing cap and transfer case housing half for later reassembly.

(2) Remove and disassemble the bearing cap assembly in the numerical sequence as illustrated on figure 5-4 and figure 5-8.

c. Cleaning. Clean all parts with approved cleaning solvent and dry with compressed air.

d. Inspection and Repair. Inspect bearing cap for cracks, wear, roughness and corrosion. Retap badly threaded holes. Replace a defective cap.

e. Reassembly. Install rear bearing cap assembly (33) for shaft IV in reverse of the numerical sequence as illustrated on figure 5-4.

(1) Test shimming by installing same number and size of shims as used originally.

(2) Torque capscrews (31) to 13-17 ft-lbs. Measure end play of shaft with a feeler gage between bearing cap and transfer case. Check for .003-.007 inch of end play. Correct improper end play by adding or removing shims as required.

Note. Be sure torque capscrews to 13-17 ft-lbs. before testing with feeler gage (fig. 5-9).

(3) When end play with hardware torqued is within proper limits, loosen capscrews and apply plastic gasket to flange surface of bearing cap, shims, and transfer case. Torque hardware to 13-17 ft-lbs.

5-7. Rear Bearing Cap Assembly, Shaft II

a. General. This assembly retains the rear bearing for countershaft II and returns oil to the lube oil pump.

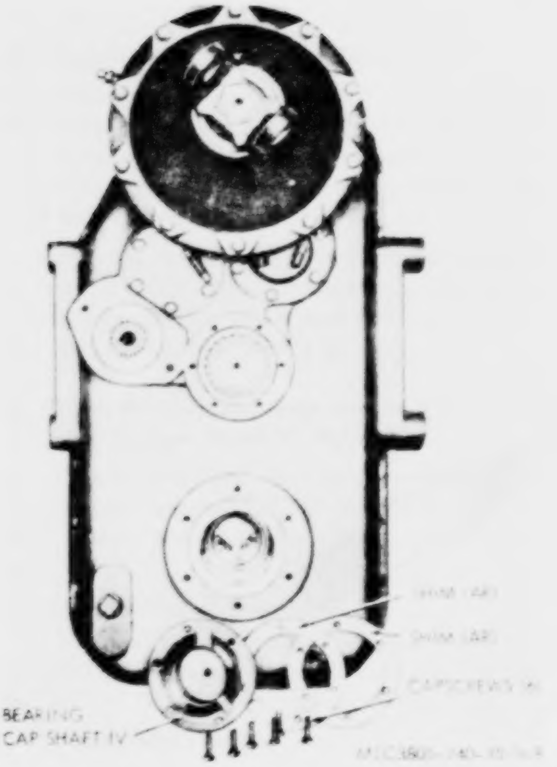


Figure 5-8. Rear bearing cap assembly, shaft IV, removal and installation.

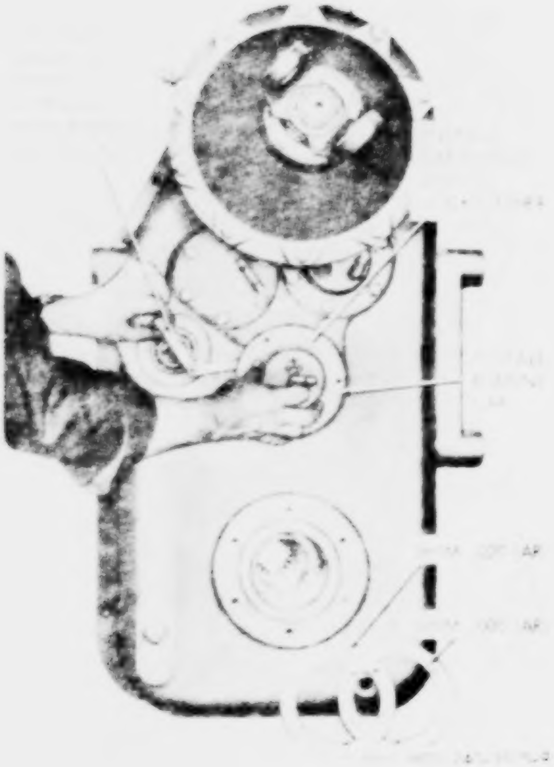


Figure 5-9. Transfer case rear bearing cap, installation checking shaft IV end play with feeler gage.

b. Removal and Disassembly.

(1) Benchmark the bearing cap for later reassembly.

(2) Remove and disassemble the bearing cap assembly in the numerical sequence as illustrated on figures 5-4 and 5-10. Clean off plastic gasket.

c. Cleaning. Clean all parts with an approved solvent and dry with compressed air.

d. Inspection and Repair.

(1) Inspect bearing cap (38, fig. 5-4) for cracks, burrs and roughness. Retap threaded holes if necessary. Replace a defective cap.

(2) Replace spacer (40, fig. 5-4).

e. Reassembly and Installation.

(1) Apply plastic gasket to flange surface of cap and transfer case.

(2) Install bearing cap assembly in reverse of numerical sequence as illustrated on figure 5-4. Torque capscrews to 13-17 ft-lbs.

5-8. Yoke, Bucket Line Output Shaft, and Rear Clutch Assembly

a. General. This assembly transmits power from the transfer case to the right-angle sprocket drive. The clutch assembly is a friction disc, oil bath type, designed to permit slipping if the bucket line strikes a solid obstacle during digging operations.

b. Removal.

(1) Benchmark the cylinder and shaft housing for later reassembly.

(2) Remove capscrews (41) and lockwashers (42). Remove yoke, bucket line output shaft and rear clutch assembly (43). Remove elbow (40) from cylinder assembly.

c. Disassembly. Disassemble yoke, bucket line output shaft, and rear clutch assembly in the numerical sequence as shown on figure 5-11.

(1) Remove nut (1), washer (2) and yoke (3).

(2) Remove cylinder assembly as shown in figure 5-12.

(3) Remove piston and friction disc assembly as shown in figure 5-13.

(4) Remove plastic gasket.

(5) Remove lock wire, spacer and friction disc assembly (12 through 15, fig. 5-11).

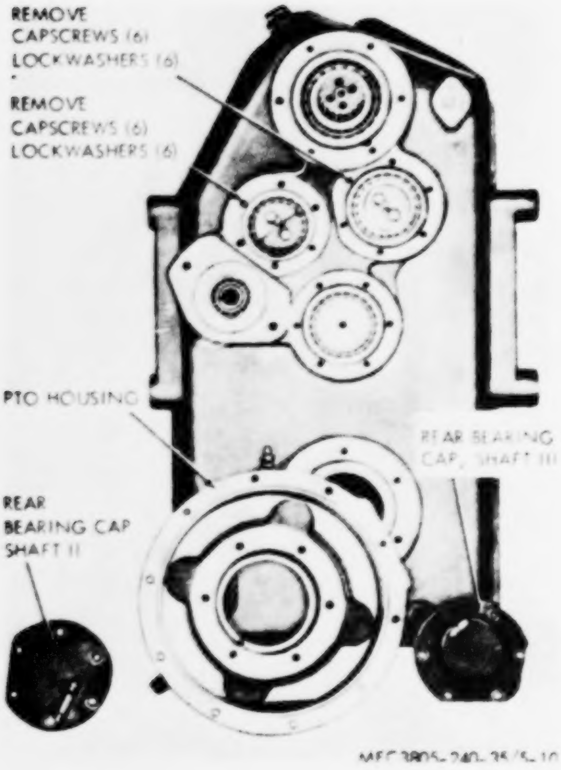


Figure 5-10. Transfer case bucket line output shaft housing and bearing cap assemblies for shafts II and III.

(6) Place cylinder assembly (7 through 10) on soft padding. Blow out piston while holding hand over rear yoke opening of cylinder (fig. 5-13). Remove piston (7, fig. 5-11), preformed packing (8), piston pin (9) and inner race (11) of ball thrust bearing.

(7) Remove oil seal (4), retaining ring (5) and bearing (6) from rear of yoke area as shown in figure 5-14.

(8) Remove bearing race (11, fig. 5-11) from clutch cone.

(9) Pull bearing (16) from rear of output shaft (20) with a ring puller and remove spacer (17), spring (18) and clutch cone (19) from shaft.

(10) Remove lockwire, two capscrews (44, fig. 5-4), end plate (45) and outer ring clutch disc (46) as shown in figures 5-4 and 5-14.

(11) Remove capscrews (50, fig. 5-4) and lockwashers (51) and remove output shaft housing (52) as shown in figure 5-16.

Note. Clean plastic gasket from output shaft housing and transfer case. Benchmark housing for reassembly.

d. Cleaning. Clean all parts with an approved cleaning solvent and dry with compressed air.

e. Inspection and Repair.

(1) Inspect yoke (3, fig. 5-11) for cracks, burrs, and wear. If necessary, tap bearing holes to be concentric with cross-hole center line within .006 inch. Remove burrs from splines by honing, where possible. Replace a defective yoke.

(2) Inspect capscrews (53, fig. 5-4), nuts (1, fig. 5-11), and cylinder housing (10) for stripped or crossed threads. Replace defective parts. Retap threads, if necessary.

(3) Replace oil seal (4) and retaining ring (5). Soak new oil seals in light, clean lubricating oil for 45 minutes before installation.

(4) Inspect bearings (6, 11, 16) for wear, roughness, spalling, pitting, scoring or burrs. Hold inner race of bearings in hand. Revolve outer race. If any roughness is encountered, replace bearings. Replace thrust bearings.

(5) Inspect spacers (14, 15, 17). Check sides of discs (12, 13) for flatness and parallelism within .002 inch T. I. R. Check friction disc spacers (14, 15) for .002 inch flatness tolerance. Replace discs and spacers which are excessively warped. Replace bearing spacers.

(6) Inspect output shaft (20) for cracks, burrs, wear, pitting, twisting and roughness. Replace defective shaft assembly.

(7) Inspect spring (18) for cracks and tension. Check spring with tensiometer. Spring must support ±50 pounds at .75 inches. Replace a defective spring.

(8) Inspect the inner surfaces of the cylinder assembly housing (10). Remove sharp edges, corrosion and forging particles.

(9) Replace preformed packing (8) in cylinder assembly. Dip new packing in brake fluid before installation.

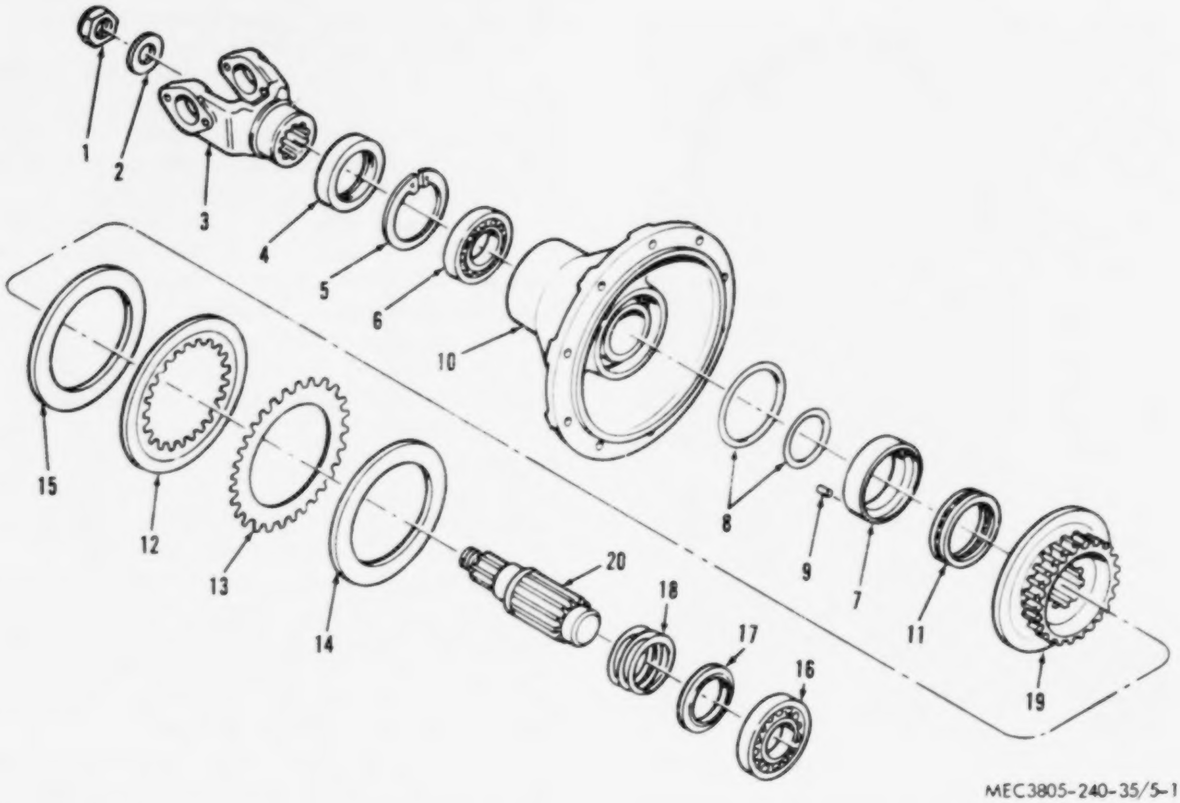
(10) Inspect piston (7) for sharp edges or blemishes on surfaces coming in contact with packing and thrust-bearing face. Remove irregularities with a hone.

(11) Replace piston pin (9).

(12) Inspect friction discs (13) for flatness and parallelism. Replace discs which exceed a tolerance of .002 inch total indicator reading.

(13) Inspect clutch cone (19) and outer ring clutch disc (46, fig. 5-4) for cracks and wear. Inspect teeth for wear and roughness. Replace defective cone or disc.

(14) Inspect shaft housing (52) for cracks and corrosion. Replace defective housing.



MEC3805-240-35/5-11

1	Nut, 1 1/4-12 in.
2	Washer, 1 1/4 in.
3	Yoke, bucket line output
4	Seal, oil
5	Ring, retaining
6	Bearing, ball
7	Piston (2 rqr)
8	Packing, preformed (2 rqr)
9	Pin, brake piston (2 rqr)
10	Cover, friction disc
11	Bearing, ball
12	Disc, opposing (4 rqr)
13	Disc, friction (5 rqr)
14	Spacer, friction disc
15	Spacer, friction disc
16	Bearing, ball
17	Spacer
18	Spring
19	Cone, clutch
20	Shaft, bucket line output

Figure 5-11. Transfer case bucket line output shaft, yoke and clutch assembly, exploded view.

f. Reassembly and Installation. Dip all parts of bucket line shaft and clutch assembly, except housings, in light, clean lubricating oil. Soak new oil seals for 45 minutes, then reassemble in reverse of the numerical sequence shown in figure 5-11.

(1) Apply plastic gasket on flange surface of PTO housing and transfer case (fig. 5-4).

(2) Aline bucket line output shaft housing (52) on transfer case (17) and install capscrews (50) and lockwashers (51). Torque screws to 23-27 ft-lbs.

(3) Install outer ring clutch disc (46), end plate (45) and two capscrews (44). Torque to 15-19 ft-lbs. Install lock-wire on two capscrews with approved safety wire method.

(4) Install outer ring clutch disc (46).

(5) Install inner friction disc spacer (fig. 5-11) and friction disc assembly (12 through 15). Install lock wire.

Note. Opposing discs (12) and friction discs (13) are assembled alternately. Position opposing disc (12) to clutch cone spacer.

(6) Install piston pin (9) in piston (7).

Caution: **When installing pin use care to prevent damage to piston thrust bearing (11) surface.**

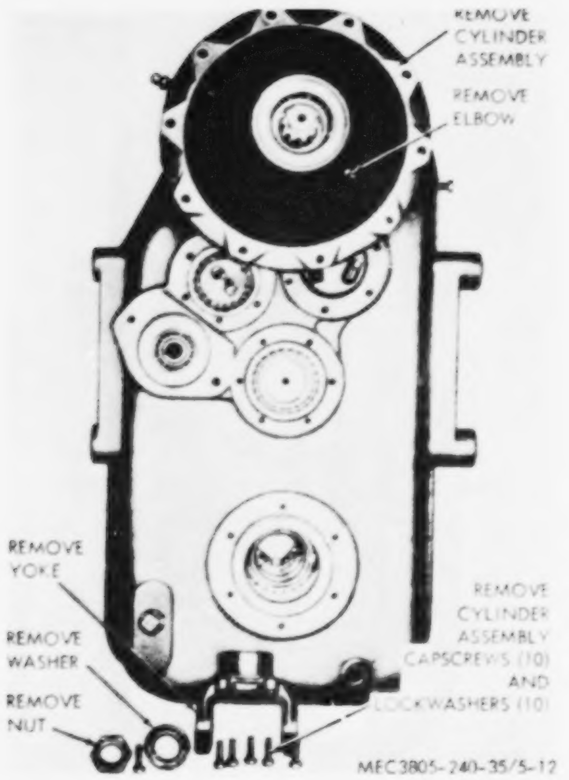

REMOVE CYLINDER ASSEMBLY
REMOVE ELBOW
REMOVE YOKE
REMOVE WASHER
REMOVE NUT
REMOVE CYLINDER ASSEMBLY CAPSCREWS (10) AND LOCKWASHERS (10)
MEC3805-240-35/5-12

Figure 5-12. Transfer case, cylinder assembly, shaft I, removal and installation.

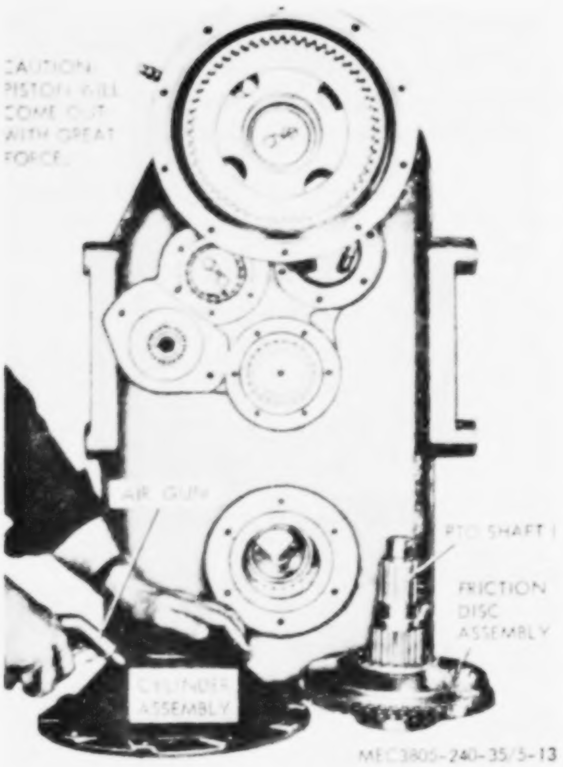

CAUTION PISTON WILL COME OUT WITH GREAT FORCE.
AIR GUN
PTO SHAFT I
FRICTION DISC ASSEMBLY
CYLINDER ASSEMBLY
MEC3805-240-35/5-13

Figure 5-13. Transfer case, piston and friction disc assembly, shaft I, removal and installation.

(7) Soak preformed packing (8) in brake fluid. Install packing, keeping twisting to a minimum.

(8) Aline piston (7) with cylinder cover (10) and install.

(9) Install bearing (6), new retaining ring (5) and new oil seal (4) in rear yoke area.

Note. **Press bearing and oil seal in place, if necessary.**

(10) Install clutch cone (19), spring (18), spacer (17) and bearing (16) on rear of output shaft (20).

Note. **Press bearing in place, if necessary.**

(11) Install thrust ball bearing in rear of clutch cone (19) and install bucket line output shaft and friction disc assemblies in cylinder assembly.

(12) Install yoke (3), washer (2) and nut (1). Tighten nut to 750 ft-lbs. torque. Apply plastic gasket to washer on flange side, next to yoke.

(13) Apply plastic gasket to flange surface of cylinder assembly housing and bucket line output shaft housing.

(14) Aline yoke, bucket line output shaft, and rear clutch assembly with output shaft housing and install capscrews and lockwashers. Torque hardware to 23-27 ft.lbs.

(15) Using a portable pressure test unit, pressure-test cylinder assembly to 1400 psi. Assembly should hold pressure for one minute without a loss of pressure.

5-9. Rear Bearing Cap Assembly, Shaft III

a. General. This assembly retains the countershaft III bearing and returns oil to the lube oil pump.

b. Removal and Disassembly.

(1) Benchmark the assembly for reassembly.

(2) Disassemble the bearing cap assembly (55) in the numerical sequence as illustrated on figure 5-4 and as shown in figure 5-10.

c. Cleaning. Clean all parts with approved cleaning solvent and dry with compressed air.

d. Inspection and Repair. Inspect bearing cap (55, fig. 5-4) for cracks, roughness and cor-

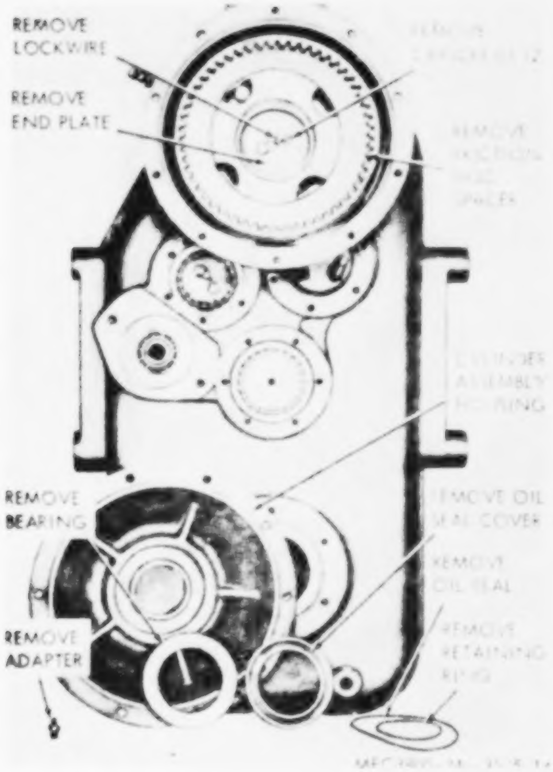


Figure 5-14. Transfer case cylinder assembly, removal and disassembly.

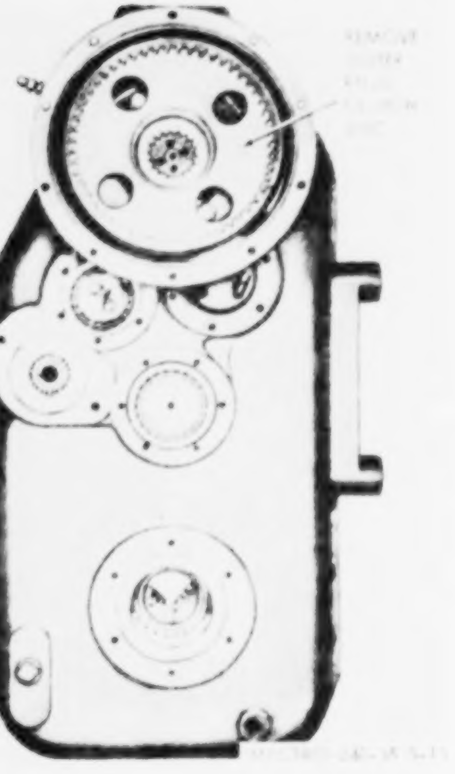


Figure 5-15. Transfer case, outer ring clutch disc, removal and installation.

rosion. Retap threads if necessary. Replace defective cap.

e. Reassembly and Installation. Reassemble bearing cap in reverse of numerical sequence as illustrated on figure 5-4.

(1) Apply plastic gasket to flange surface of bearing cap and transfer case.

(2) Tighten capscrews (53) to 13-17 ft-lbs.

5-10. Yoke and Front Clutch Assembly

a. General. When engaged, this assembly locks out the differential action between front and rear wheels.

b. Removal and Disassembly.

(1) Install two mounting bolts on each side of transfer case. Using a suitable hoist, place case assembly on its back with the end of V shaft resting on a block of soft wood (fig. 5-17).

(2) Remove yoke and front clutch assembly in the numerical sequence as illustrated on figure 5-4 and figure 5-18.

(3) Benchmark the cylinder assembly housing and differential housing.

(4) Disassemble front clutch assembly in the numerical sequence as illustrated on figure 5-19.

(5) Disassemble spacer (3), clutch friction discs (4, 5) and clutch assembly (62, fig. 5-4).

Note. Front clutch assembly does not contain a retaining ring.

c. Cleaning. Clean all parts with approved cleaning solvent and dry with compressed air.

d. Inspection and Repair. Inspect yoke (58) and front clutch assembly (62) and repair or replace defective parts.

Note. This yoke and front clutch assembly does not contain a retaining ring, shaft, spring or bearing spacer. Refer to paragraph 5-8 for clutch outer ring repair instructions.

e. Reassembly, Installation, and Final Testing. Reassemble and install front clutch assembly in reverse of numerical sequence as illustrated on figures 5-19 and 5-4.

(1) Dip bearings and friction disc assembly in light, clean lubricating oil. Soak new oil seal for 45 minutes before installation.

(2) Reassemble spacers (3, 6) friction discs (4, 5) and clutch cone (7) (fig. 5-19).

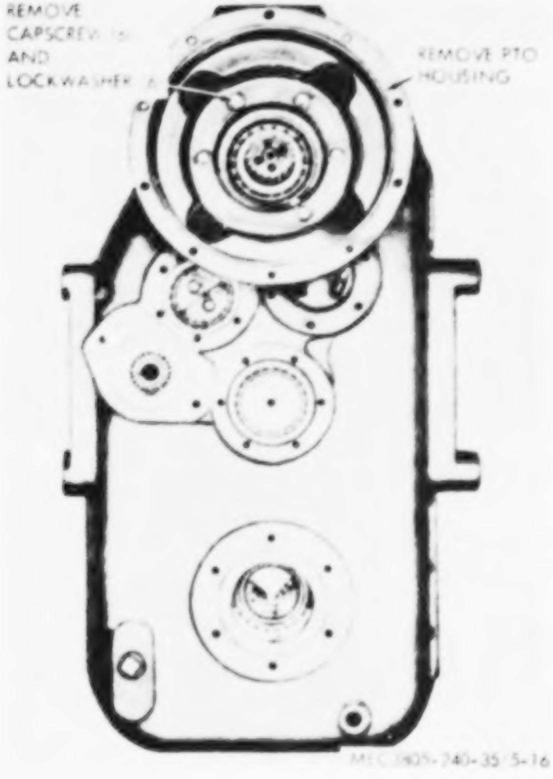


Figure 5-16. Transfer case, bucket line output shaft housing, removal and installation.

(3) Reassemble cylinder assembly.

(4) Install friction disc and clutch cone assembly (62, fig. 5-4). Replace lockwire.

(5) Apply plastic gasket to flange surface of cylinder assembly and differential housing (68).

(6) Install thrust ball bearing (8, fig. 5-19) in rear of clutch cone (7).

(7) Aline cylinder assembly (62, fig. 5-4) and install. Tighten capscrews to 23-27 ft-lbs of torque.

(8) Install yoke (58), washer (57) and nut (56). Tighten nut to 750 ft-lbs of torque. Apply plastic gasket to washer on flange side next to yoke.

(9) Using a portable pressure test unit, check cylinder assembly for 1400 psi. Reject an assembly which does not hold pressure for one minute without loss.

5-11. Differential and Power-Divider Assembly

a. General. This assembly consists of a longitudinally mounted differential which provides differential rotation of front and rear axle shafts.

b. Removal and Disassembly.

(1) Remove the differential and power divider assembly (68, fig. 5-4) from the transfer case in the numerical sequence as illustrated on figure 5-4.

(2) Break plastic gasket and remove bearing cup (69). Use a soft drift pin and driver spacer (70) from rear of transfer case (fig. 5-20).

(3) Benchmark power divider housing. Cut lockwires between each pair of capscrews (8, fig. 5-21), and disassemble power divider assembly in the numerical sequence as illustrated on figure 5-21. Refer to figures 5-22 through 5-26.

(4) Remove power divider pin (14) from block (15) and case (21) as shown in figure 5-21.

(*a*) Place a 1 1/2 in. socket on housing over pin.

(*b*) Thread a 1/2-20 N.F. bolt or capscrew into pin and pull pin from block and housing.

(*c*) Block, pinion gears and thrust washer will fall out.

c. Cleaning. Clean all parts with approved cleaning solvent and dry with compressed air.

d. Inspection and Repair.

(1) Clean teeth of gears (6, 12, 16, fig. 5-21) thoroughly. Inspect for wear, cracks, burrs and broken teeth. Remove burrs with a hone, where possible. Replace defective gears.

(2) Inspect housing and cases (1, 9, 21) for roughness, gouges on the flange surfaces, corrosion and pitting. Inspect threaded holes and retap if necessary. Replace defective parts.

(3) Inspect outer ring clutch disc (64, fig. 5-4) for wear, burrs, gouges, corrosion and pitting. Replace if defective.

(4) Inspect pinion shaft (18, fig. 5-21) and pinion shaft gear teeth for wear, cracks, burrs, twisted splines, roughness and galling. Replace defective pinion shaft.

(5) Inspect bearings (2, 3, 4) for wear, galling and roughness. Replace defective bearing cups (2) and cones (3, 4).

(6) Inspect block (15) and pins (13) for roughness, sharp edges and wear. Replace defective units.

(7) Replace all thrust washers (11, 17, 19), bushings (20), keys (7) and retaining rings (5) (also 63, fig. 5-4).

(8) Inspect spacers (70, fig. 5-4) for roughness, pitting or corrosion. Replace a defective spacer.

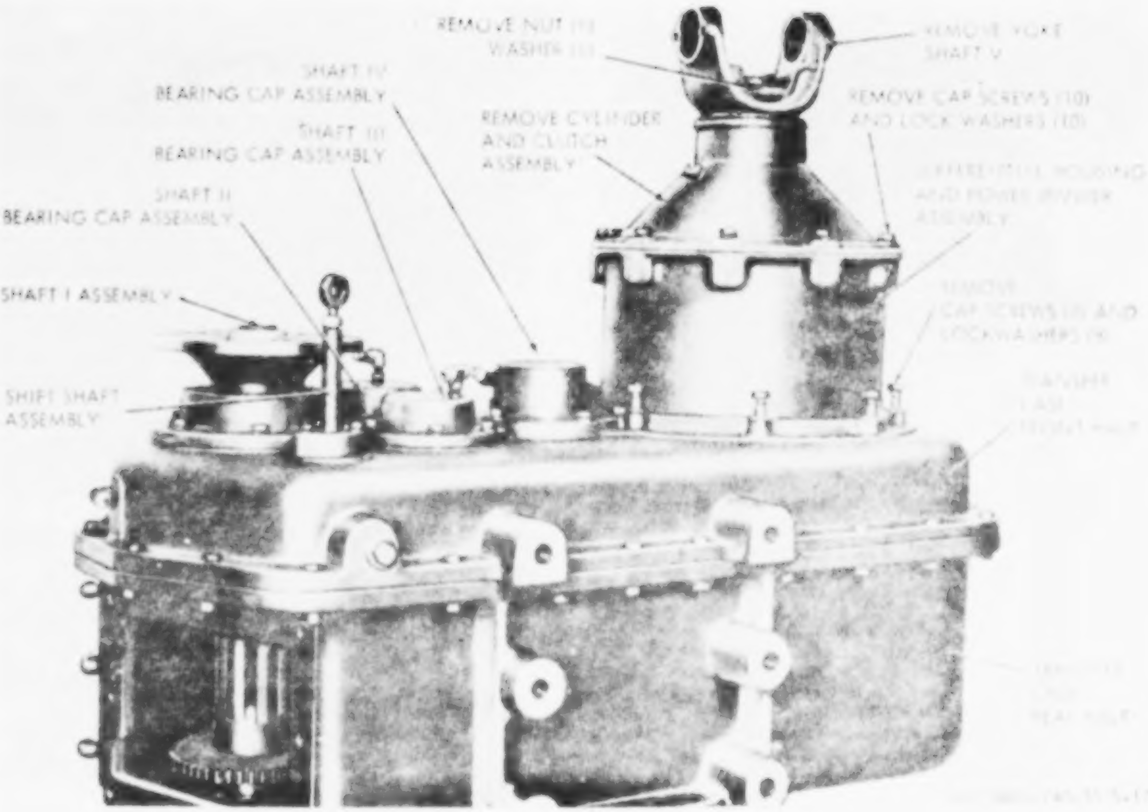

REMOVE NUT (1)
WASHER (1)
REMOVE YOKE
SHAFT V
SHAFT IV
BEARING CAP ASSEMBLY
REMOVE CYLINDER
AND CLUTCH
ASSEMBLY
REMOVE CAP SCREWS (10)
AND LOCK WASHERS (10)
SHAFT III
BEARING CAP ASSEMBLY
DIFFERENTIAL HOUSING
AND POWER DIVIDER
ASSEMBLY
SHAFT II
BEARING CAP ASSEMBLY
SHAFT I ASSEMBLY
REMOVE
CAP SCREWS (8) AND
LOCKWASHERS (8)
SHIFT SHAFT
ASSEMBLY
TRANSFER
CASE
FRONT HALF
TRANSFER
CASE
REAR HALF

Figure 5-17. Transfer case prepared for front cylinder removal.

e. Reassembly and Installation. Reassemble differential and power divider assembly (68) in reverse of numerical sequence as illustrated on figure 5-21.

(1) Dip all parts in light, clean lubricating oil.

(2) Install new lockwire and safety-wire the capscrews on the power divider housing.

Note. Install pinion gear thrust washer (19, fig. 5-21) with ground side next to gear.

(3) Using a soft hammer, install pinion pins (14) in housing (21). Place thrust washers (17), pinion gears (16) and block (15) in position. Do not drive pin all the way in. Leave about 1/4 inch protruding.

(4) Tighten power divider capscrews (8) to 80-90 ft-lbs torque with dry thread or 25-30 ft-lbs lubricated.

(5) Apply a thin coat of plastic gasket to flange surface of differential housing and transfer case.

(6) Install bearing cup (69, fig. 5-4) and spacer (70) on rear of transfer case.

(7) Install differential and power divider assembly in reverse of numerical sequence as illustrated on figure 5-4. Tighten differential housing capscrews (66) to 33-42 ft-lbs of torque.

5-12. Speedometer Gear Housing Assembly

a. General. This assembly contains a drive gear and driven gear which transmit rotary motion to a flexible shaft assembly and thence to the speedometer gauge. The housing assembly also retains the front bearing cup and cone for shaft IV and returns lube oil to the pump.

b. Removal and Disassembly. Remove and disassemble the speedometer gear housing assembly in the numerical sequence as illustrated on figure 5-4, and as shown in figures 5-27 and 5-28. Benchmark parts before removal.

(1) Break plastic gasket.

(2) Cut lock wire and remove capscrews (74, fig. 5-4).

(3) Remove gear housing (76) with driven gear (73) and adapter (72).

(4) Remove adapter (72) and driven gear (73).

c. Cleaning. Clean all parts with approved cleaning solvent and dry with compressed air.

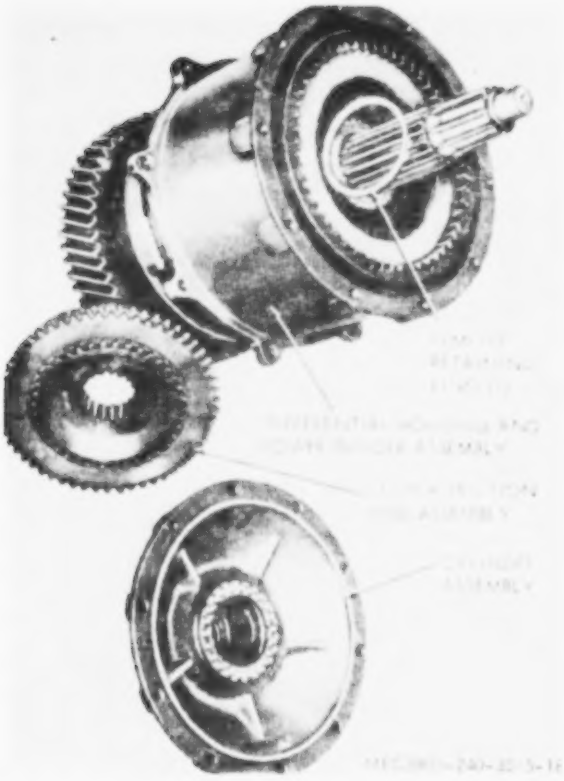


Figure 5-18. Transfer case differential housing and front clutch assemblies.

d. Inspection and Repair.

(1) Inspect gear housing (76) and end plate (78) for cracks and roughness. Clean passages thoroughly; inspect and retap threads if necessary. Replace defective parts.

(2) Replace bearing spacer (81).

(3) Inspect drive gear (8) for cracked, broken, worn, sharp or burred teeth. Remove burrs by stone honing. Replace a defective gear.

(4) Inspect driven gear (73) and shaft. Inspect teeth for cracks, breaks, twisting, sharpness and burrs. Inspect shaft for out-of-roundness and distortion. Replace a defective driven gear.

(5) Inspect adapter (72) for thread wear and retap if necessary. Inspect for wear, cracks and roughness. Replace a defective adapter.

e. Reassembly and Installation. Reassemble and install the speedometer gear housing assembly in reverse of numerical sequence illustrated on figure 5-4, and shown in figures 5-27 and 5-28.

(1) Apply a thin coat of plastic gasket to flange surface of gear housing and transfer case.

(2) Tighten end plate capscrews (77, fig. 5-4) to 15-19 ft-lbs of torque. Install new lock wires. Tighten housing capscrews (74) to 23-27 ft-lbs of torque.

5-13. Front Bearing Cap Assembly, Shaft III

a. General. This assembly retains the front bearing cup and returns lube oil to the pump.

b. Removal and Disassembly. Benchmark the bearing cap and remove the bearing cap assembly (84, fig. 5-4) in the numerical sequence as illustrated on figures 5-4 and 5-27.

c. Cleaning. Clean all parts with approved solvent and dry with compressed air.

d. Inspection and Repair. Inspect cap for cracks, roughness and corrosion. Retap threads if necessary. Replace a defective cap and any defective hardware.

e. Reassembly. Install front bearing cup assembly in reverse of numerical sequence as illustrated on figure 5-4.

(1) Apply a thin coat of plastic gasket to flange surface of cap and transfer case.

(2) Replace shims (85, 86) and allow .003—.007 in. end play. Refer to paragraph 5-5 and figure 5-9 for end play inspection procedure.

(3) Tighten capscrews (82) to 13-17 ft-lbs torque.

5-14. Front Bearing Cap Assembly, Shaft II

a. General. This assembly retains the bearing cup and returns lube oil to the pump.

b. Removal and Disassembly. Benchmark the bearing cap and remove the assembly in the numerical sequence as illustrated on figure 5-4 and as illustrated in figure 5-27.

c. Cleaning. Clean all parts with approved solvent and dry with compressed air.

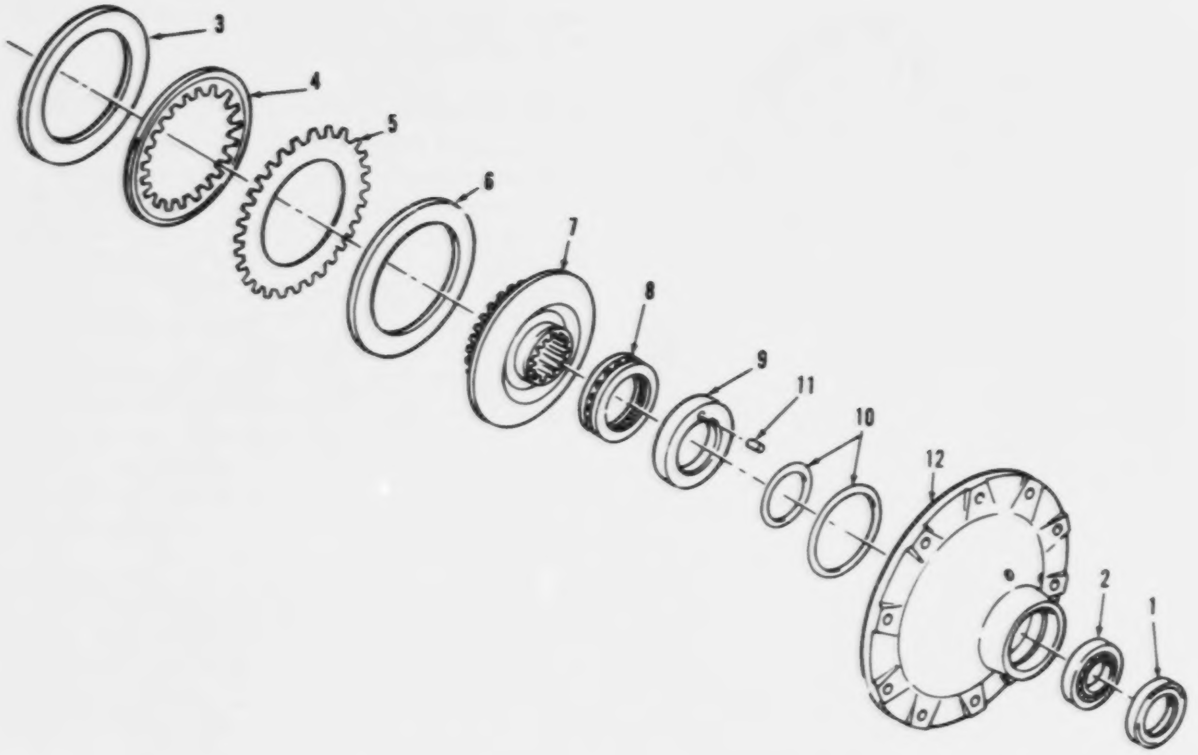
d. Inspection and Repair. Inspect bearing cap (89, fig. 5-4) for cracks, roughness and corrosion. Retap threads, if necessary. Replace a defective cap and any defective hardware.

e. Reassembly and Installation. Install front bearing cap (89) in reverse of numerical sequence as illustrated on figure 5-4.

(1) Apply a thin coat of plastic gasket to the flange surface of the cap and transfer case.

(2) Replace shims (90, 91) and allow .003-.007 in. end play. Refer to paragraph 5-5 and figure 5-9 for end play inspection procedure.

(3) Tighten capscrews (87) to 13-17 ft lbs torque.



MEC3805-240-35/5-19

1	Seal, oil
2	Bearing
3	Spacer, friction disc
4	Disc, opposing (4 rqr)
5	Disc, friction (4 rqr)
6	Spacer, friction disc
7	Cone, clutch
8	Bearing, thrust ball
9	Piston (2 rqr)
10	Packing, preformed (2 rqr)
11	Pin, brake piston (2 rqr)
12	Cover, friction disc

Figure 5-19. Transfer case front clutch assembly, exploded view.

5-15. Front Input Flange and Bearing Retainer Assembly, Shaft I

a. General. The input flange transmits torque from the transmission to the transfer case. The bearing-retainer assembly retains the bearing cup and returns lube oil to the pump.

b. Removal and Disassembly. Benchmark the bearing retainer and disassemble retainer and flange assemblies in the numerical sequence as shown in figures 5-4 and 5-27.

c. Cleaning. Clean all parts with approved solvent and dry with compressed air.

d. Inspection and Repair.

(1) Inspect flange (94 fig. 5-4) for cracks, gouges, galling, cracked splines and wear. Retap threaded holes if necessary.

(2) Inspect bearing retainer (98) for wear, corrosion, pitting and roughness. Clean ports thoroughly. Retap threaded holes, if necessary. Replace defective retainer.

(3) Replace oil seal (95, fig. 5-4).

(4) Replace shims (99, 100).

e. Reassembly and Installation. Reassemble and install the input flange and bearing retainer assembly in reverse of numerical sequence as illustrated on figure 5-4.

(1) Apply a thin coat of plastic gasket to washer flange side and flange surface of bearing retainer.

(2) Add or remove shims to allow .003-.007 in. end play. Refer to paragraph 5-5 and figure 5-9 for end play inspection procedure.

5-16. Transfer Case Front Half and Miscellaneous Parts

a. General. The shift rod connects the shifter forks to the operator's controls. The detent assem-

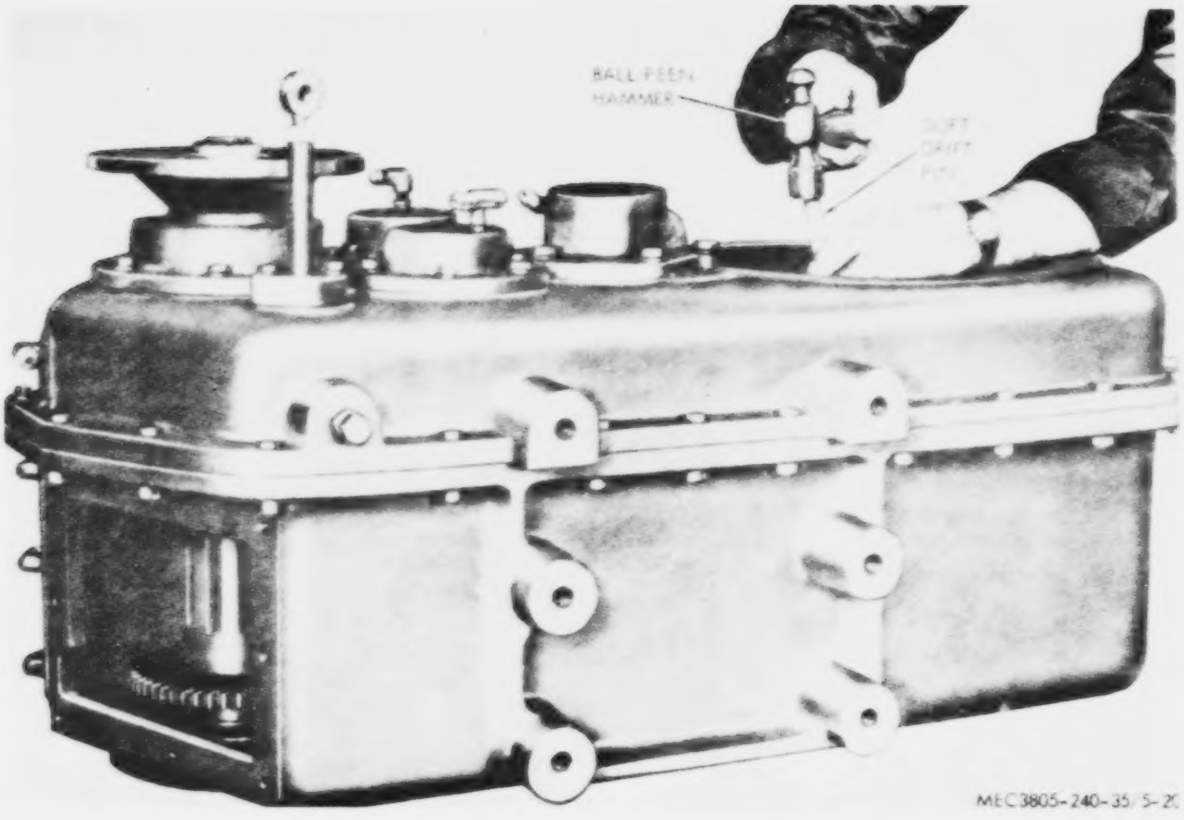


Figure 5-20. Transfer case spacer and bearing removal, shaft V.

bly is used to hold the shift rail in any of three positions. The two dowel pins are used to aline the front and back halves of the transfer case.

Note. Transfer case front and rear halves are match-bored and must be replaced as a unit.

b. Removal and Disassembly. Remove and disassemble the transfer case front half (116) and miscellaneous parts in the numerical sequence as illustrated on figure 5-4 and as shown in figure 5-29.

(1) Loosen jam nut (102, fig. 5-4) on rod end (101) and remove rod end and nut.

(2) Remove two capscrews (103) and lockwashers (104) and remove guide assembly (105).

(3) Remove oil seal (106).

(4) Loosen jam nut (109) and remove capscrew (108), jam nut and spring.

(5) Drive dowel pin (112) from front half of transfer case (fig. 5-27).

Note. Do not drive dowel pin from back half unless it is defective and needs replacement. Using a hoist and chain cradle, lift case about two inches off block. Remove capscrews and lockwashers. Strike flanged lips of case with soft mallet. Back half of case will fall away (fig. 5-30). When front half of case clears shift rail, remove detent ball (111, fig. 5-4).

c. Cleaning. Clean all parts with approved cleaning solvent and dry with compressed air.

d. Inspection and Repair.

(1) Inspect rod end (101) eye for wear. Roughness and out-of-roundness. Inspect for cracks or gouging. Retap if necessary. Replace a defective rod end.

(2) Inspect guide (105) for wear and roughness. Replace defective guide.

(3) Replace oil seal (106) and gasket (107).

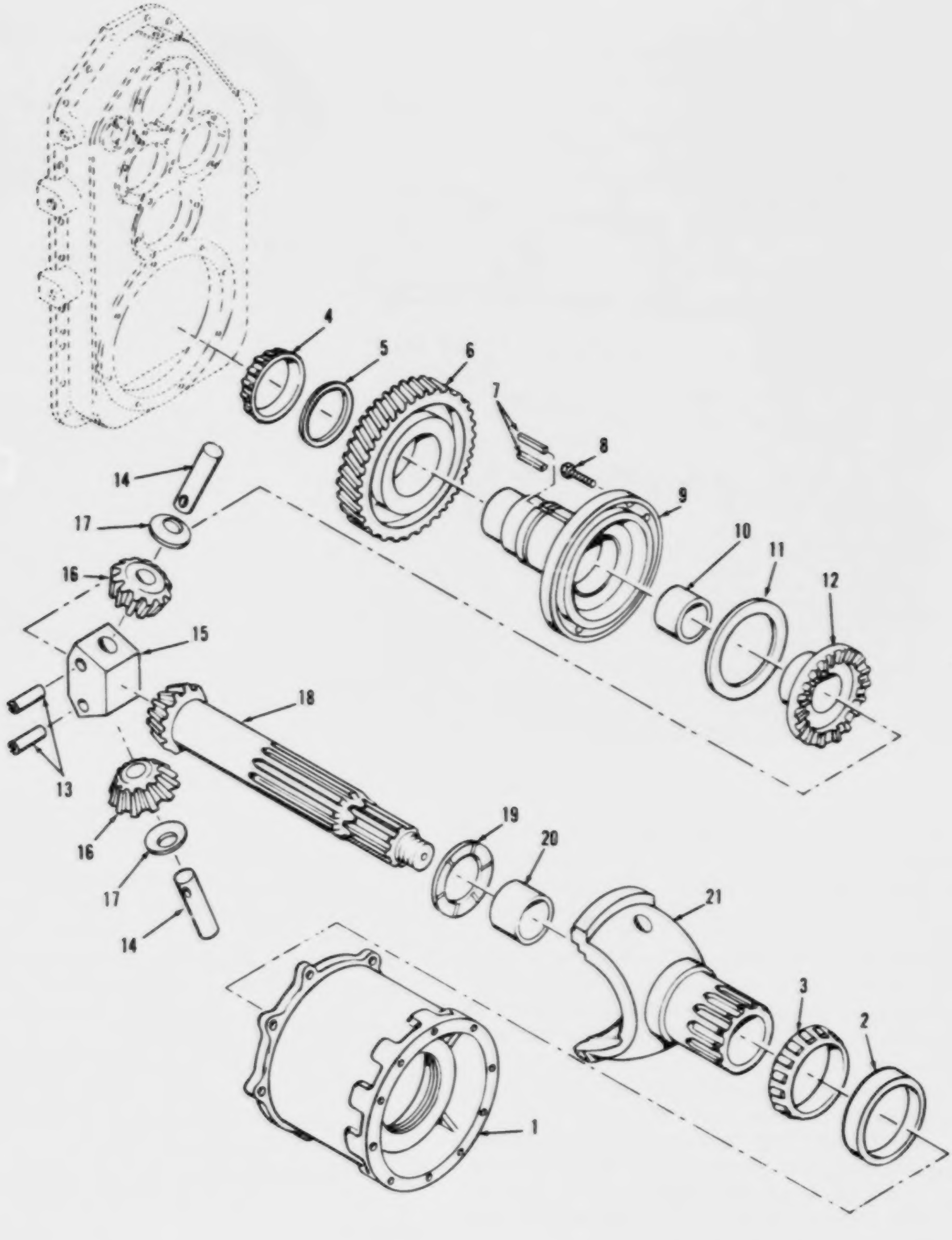
(4) Inspect spring (110) for cracks and wear. Check tension of spring for ±3.5 lbs. at 1/4 in. Replace defective spring.

(5) Inspect detent ball (11) for wear, chips, gouges and out of-roundness. Replace defective ball.

e. Reassembly and Installation. Reassemble and install front half of transfer case (116) and miscellaneous parts in reverse of numerical sequence as illustrated on figure 5-4.

(1) Apply thin coat of plastic gasket on flange surface of front and rear half of transfer case.

(2) Install transfer case capscrews (113).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MEC3805-240-35/5-2

1 Housing, differential lock
2 Cup, bearing
3 Cone, bearing
4 Cone, bearing

Figure 5-21. Transfer case differential housing and power divider assembly, exploded view.

5	Ring, retaining
6	Gear, helical, 57T
7	Key (2 rqr)
8	Screw, 1/2-20 x1 1/2 in. (10 rqr)
9	Case, rear power divider
10	Bushing, bronze
11	Washer, thrust
12	Gear, power divider side, 30T
13	Pin, roll (2 rqr)
14	Pin, power divider gear (2 rqr)
15	Block, power divider center
16	Gear, power divider pinion, 16T (2 rqr)
17	Washer, thrust (2 rqr)
18	Shaft, pinion drive
19	Washer, thrust
20	Bushing, bronze
21	Case, front power divider

Figure 5-21—Continued

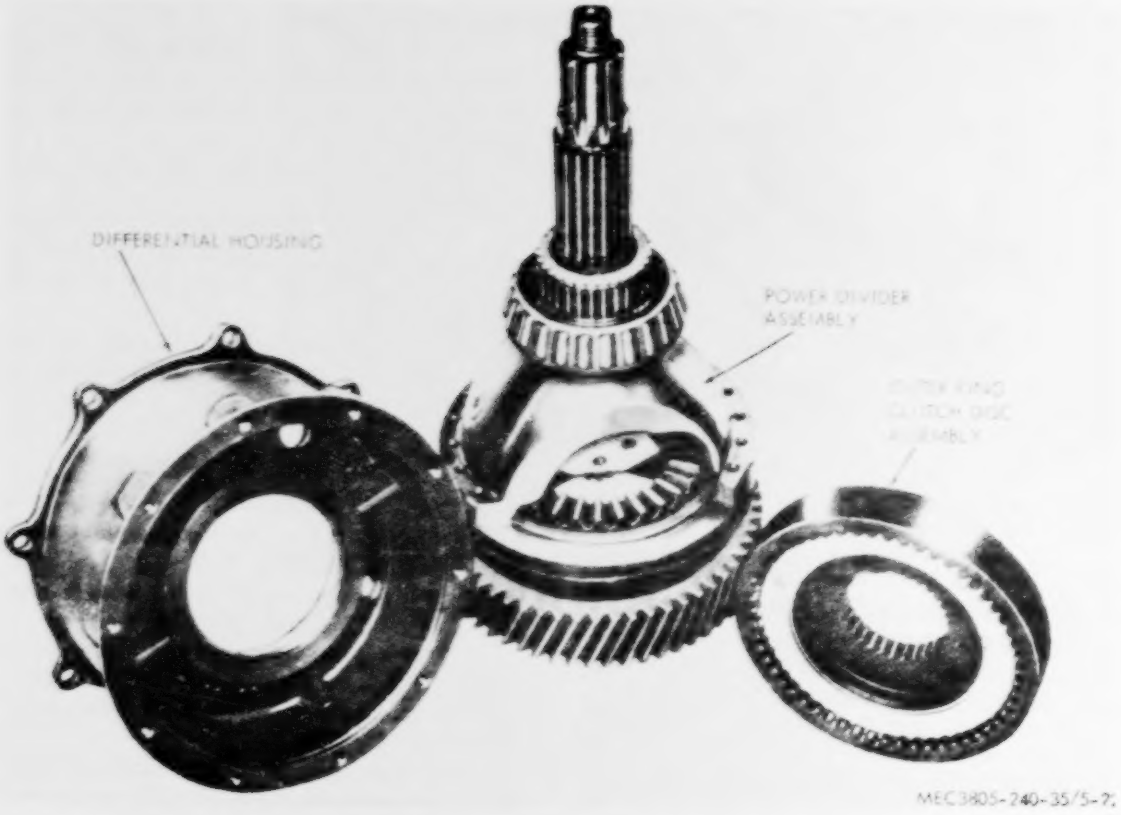


Figure 5-22. Transfer case differential housing and power divider assemblies, removal.

5-17. Transfer Case Countershaft IV Assembly

a. General. This shaft contains gears controlling high and low speed ranges. Low speed is achieved when a spur gear engages a sliding gear on countershaft III. High speed is achieved by engaging the high speed sliding gear on shaft I with internal teeth on the spur gears of shaft I.

b. Removal and Disassembly.

(1) Using a rope sling, remove shaft IV assembly (117) from transfer case as shown in figure 5-4.

(2) Disassemble countershaft assembly in the numerical sequence as illustrated on figure 5-31 and as illustrated in figures 5-32 and 5-33.

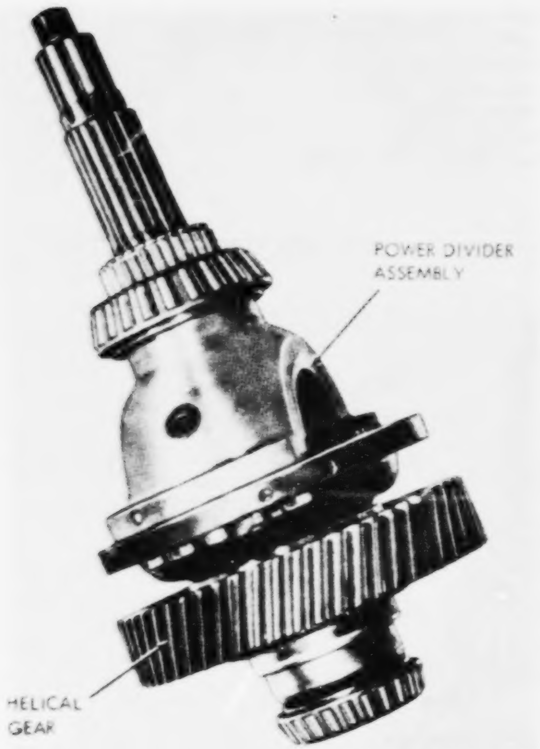
Note. Bearing cones and gears are press-fitted and will require an arbor press with bridges or a suitable bridge and puller. Remove bearing cones from each end of shaft before removing gears.

c. Cleaning. Clean parts thoroughly with approved solvent and dry with compressed air. Use brush to clean gear teeth and shaft splines.

d. Inspection and Repair.

(1) Inspect bearing cones (1, 2, fig. 5-31) for wear, pitting and corrosion. Replace defective cones.

(2) Inspect gear teeth for cracks, burrs, wear, spalling, pitting, cracking, chipping and flaking. Inspect key slots for wear, burring and



MEC 3805-240-35/5-23

Figure 5-23. Transfer case power divider assembly.

gouging. Remove burrs and light gouges with a hone. Replace defective gears. Replace keys (5).

(3) Inspect countershaft (7) for roughness, gouges, pitting and wear. Remove light gouges and burrs with hone. Replace defective shaft.

e. Reassembly and Installation. Reassemble and install countershaft IV assembly in reverse of numerical sequence as illustrated on figures 5-31 and 5-4.

(1) Lubricate gears and cones.

(2) Using arbor press or portable press, fit gears and cones to shaft in numerical order indicated.

5-18. Shift Shaft Assembly

a. General. The shift shaft assembly engages and disengages the sliding low range gear on countershaft III and the upper highspeed sliding gear on countershaft I.

b. Removal and Disassembly. Remove and disassemble the shift shaft assembly in the numerical sequence as illustrated on figures 5-4 and 5-34 and as shown in figure 5-35.

(1) Cut lock wire and remove lock screws (118, fig. 5-4) through top of transfer case.

(2) Remove shift shaft (3, fig. 5-34) toward front of transfer case. Lift shifter forks (1, 2) through top opening in transfer case.

c. Cleaning. Clean all parts with approved cleaning solvent and dry with compressed air

d. Inspection and Repair.

(1) Inspect shift shaft (3) detents for wear, sharpness and out-of-roundness. Inspect body of shift shaft for wear and straightness. Discard a distorted or worn shaft.

(2) Inspect shifter forks (1, 2) for wear, cracks and burrs. Remove burrs with a hone. Replace defective parts.

e. Reassembly and Installation. Reassemble and install the shift shaft assembly in reverse of numerical sequence as illustrated in figures 5-4 and 5-34.

(1) Dip all parts in light engine oil before reassembly.

(2) Install shifter forks (1, 2, fig. 5-34) with lockscrews (118, fig. 5-4). Position threaded holes toward top of case and offset of fork pointed forward.

(3) Install shift shaft (3, fig. 5-34) and aline detent in shaft with shifter forks. Install lockscrews and lock wire.

5-19. Transfer Case Countershaft III

a. General. Countershaft III contains a low-range sliding gear which engages the crowd drive motor during digging and operates as a road travel gear when crowd drive is disengaged. It can also hold neutral position.

b. Removal and Disassembly. Remove countershaft III assembly as illustrated on figure 5-36 and disassemble in the numerical sequence as illustrated on figure 5-37.

(1) Lift the sliding shift gear on shaft I to clear spur gear on shaft III. Lift countershaft III assembly from transfer case.

(2) Using arbor press or bridge and puller, remove bearing cones (1, 5) and the large spur gear (fig. 5-38).

c. Cleaning. Clean all parts thoroughly with approved cleaning solvent and dry with compressed air.

d. Inspection and Repair.

(1) Inspect shaft (8) splines for cracks, breaks, burrs, twists and wear. Replace defective shaft.

(2) Inspect gear (7) teeth and splines for breaks, cracks, spalling, pitting, flaking, distortion, chipping and wear. Remove burrs with a hone. Replace defective gears. Replace defective cones.

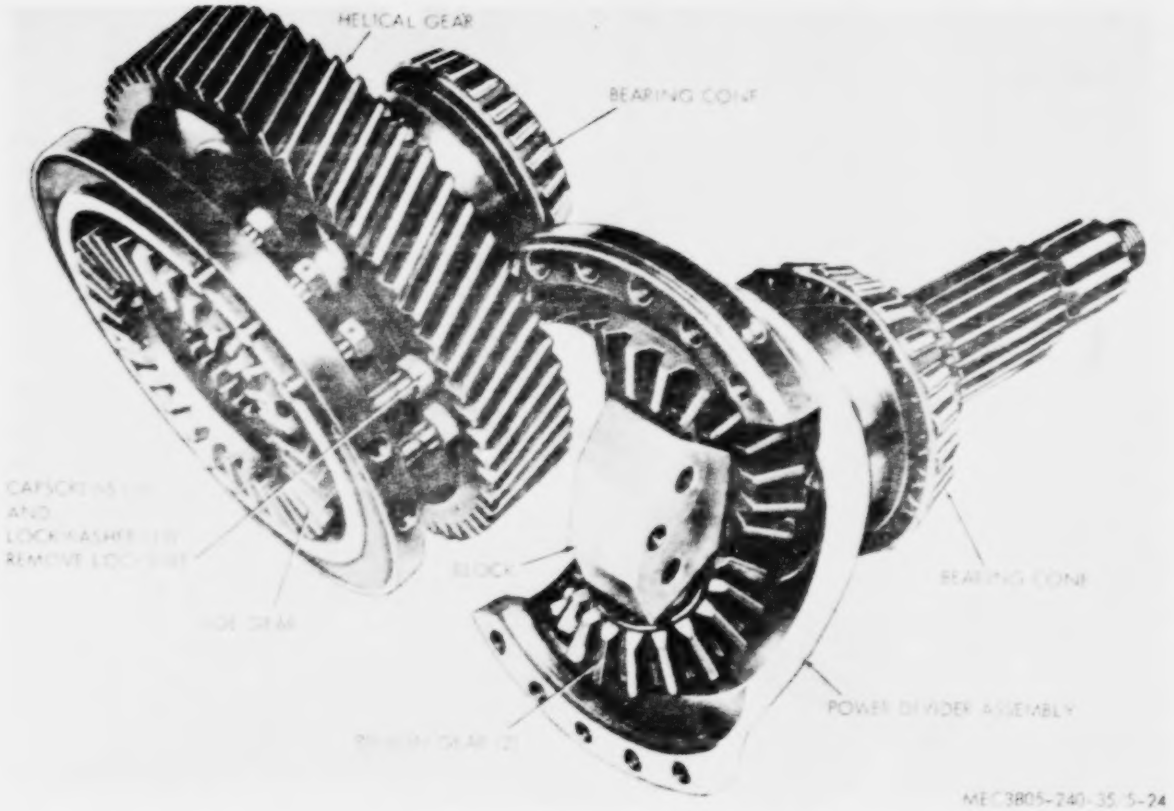


Figure 5-24. Transfer case power divider assembly, disassembled.

(3) Inspect end cap (4) for breaks and cracks. Replace defective cap.

e. Reassembly and Installation. Reassemble and install countershaft III assembly in reverse of numerical sequence as illustrated on figure 5-38 and as shown in figure 5-37.

Note. Lubricate all parts with light engine oil before installation.

5-20. Transfer Case Countershaft II

a. General. Countershaft II is driven by the crowd drive motor.

b. Removal and Disassembly.

(1) Remove countershaft II assembly in the numerical sequence as illustrated on figure 5-4. Disengage counter shaft II assembly by tilting it, as shown in figure 5-39.

(2) Disassemble countershaft II assembly in the numerical sequence as illustrated on figure 5-41.

c. Cleaning. Clean all parts thoroughly with approved cleaning solvent and dry with compressed air.

d. Inspection and Repair.

(1) Inspect ball bearings (5, 7) by holding inner race and slowly turn outer race. Listen for loud running, irregular noises and rough operation. Replace rough-running bearings. Inspect all bearings and cones for wear, roughness, pitting, corrosion and cracks. Replace defective bearings.

Note. Refer to TM 9-214 for more detailed instructions on proper care and inspection of ball bearings.

(2) Replace Spacers (4, 6).

(3) Inspect gear (8, 13) teeth for cracks, breaks, twists and burrs. Remove burrs with a hone. Replace defective gears.

(4) Inspect shaft (14) for roughness, corrosion, pitting and wear. Inspect shaft teeth for cracks, breaks, twisting and burrs. Remove burrs with a hone. Replace a defective shaft.

(5) Inspect end plate (2, 10) for cracks and gouges. Replace defective caps.

e. Reassembly and Installation. Reassemble and install countershaft II assembly in reverse of the numerical sequence as illustrated on figures 5-41 and 5-4.

(1) Dip parts in light engine oil before reassembly.

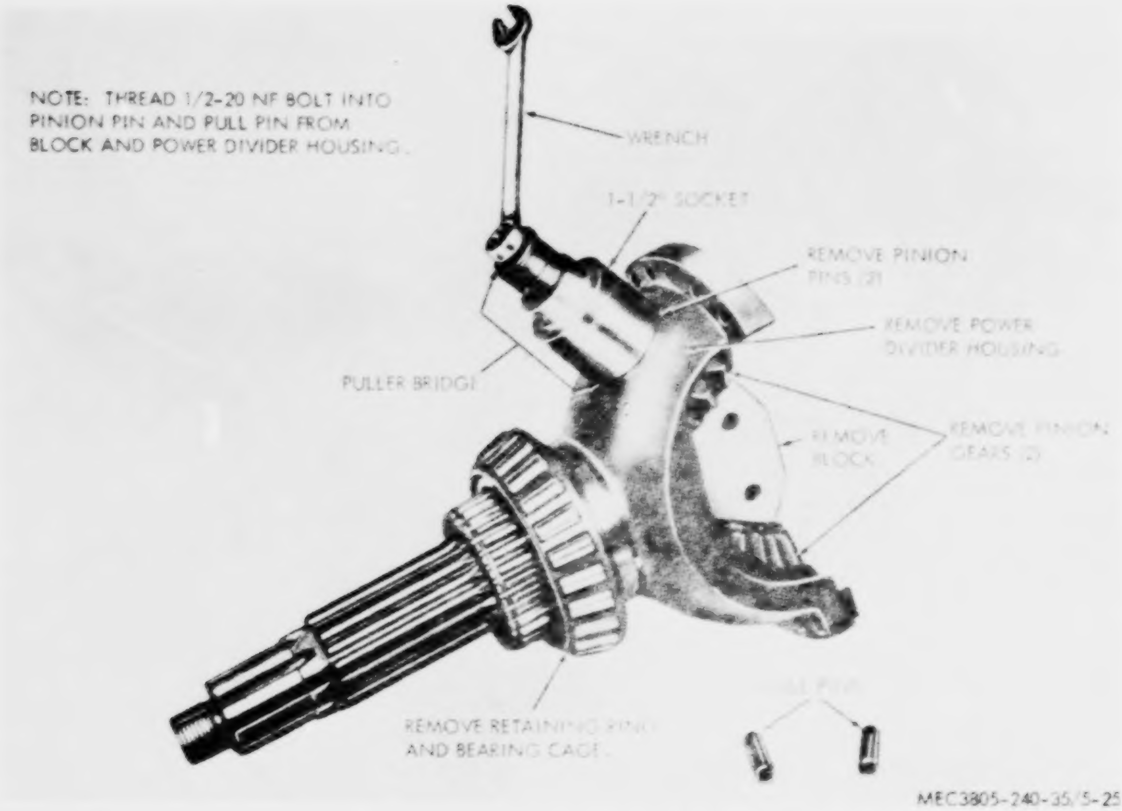

NOTE: THREAD 1/2-20 NF BOLT INTO PINION PIN AND PULL PIN FROM BLOCK AND POWER DIVIDER HOUSING.
WRENCH
1-1/2" SOCKET
REMOVE PINION PINS (2)
REMOVE POWER DIVIDER HOUSING
PULLER BRIDGE
REMOVE BLOCK
REMOVE PINION GEARS (2)
REMOVE RETAINING RING AND BEARING CAGE.
MEC3805-240-35/5-25

Figure 5-25. Transfer case power divider pin removal.

(2) Insert ball bearing (5) and spacer (4) in one side of gear; then insert spacer (6) and bearing (7) in the gear (8). Press bearings in place with care, keeping them flush with sides of gear.

5-21. Transfer Case Countershaft I

a. General. This assembly transmits torque from the transmission to the right-angle sprocket drive.

b. Removal and Disassembly. Remove and disassemble countershaft I in the numerical sequence as illustrated on figures 5-4 and 5-44 and as shown in figures 5-42 and 5-43.

Note. Be careful in removing ball bearings from gear. Use a bridge and puller to remove bearing cones (3, 5, fig. 5-44) and oil pump gear (10).

c. Cleaning. Clean all parts thoroughly with approved solvent and dry with compressed air.

d. Inspection and Repair.

(1) Inspect teeth of gears (6, 8, 10) and all splines for cracks, breaks, distortion, burrs, pitting spalling, flaking and wear. Remove burrs and small gouges with a hone, where possible. Replace defective gears.

(2) Inspect shaft (11) for roughness, pitting and corrosion. Inspect shaft spline for cracks, breaks, distortion, burrs, gouging and wear. Remove burrs with a hone, where possible. Replace a defective shaft.

(3) Inspect bearing cones (1, 9) for roughness, wear, pitting and corrosion. Replace defective cones.

(4) Inspect ball bearings (3, 5). Hold inner race of bearings with one hand and slowly turn outer race. Listen for noisy, rough or uneven operation. Inspect balls for wear, pitting and corrosion. Replace defective bearings.

Note. Refer to TM 9-214 for more detailed instructions on proper handling of bearings.

(5) Replace spacers (2, 4, 7).

e. Reassembly and Installation. Reassemble and install countershaft I in reverse of numerical sequence as illustrated on figures 5-44 and 5-4. Reassemble bearings (3, 5) and spacer (4) in spur gear (6) with bearings flush with side of gear.

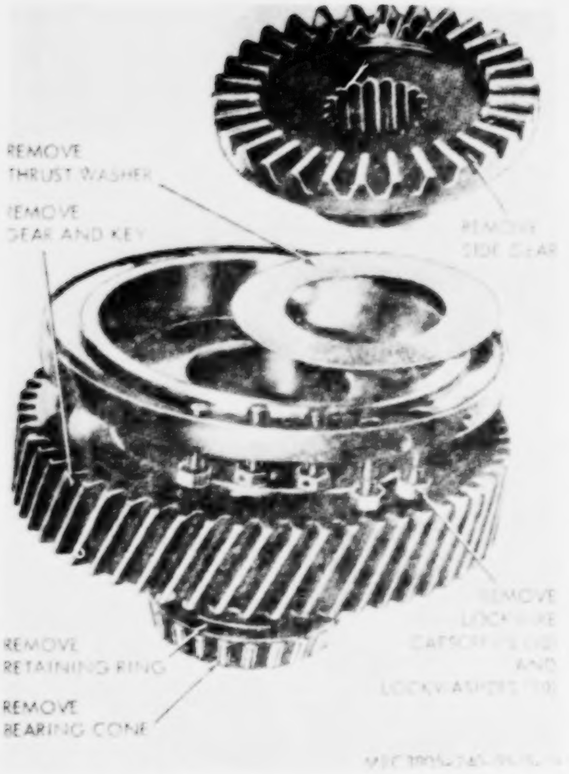

REMOVE
THRUST WASHER
REMOVE
GEAR AND KEY
REMOVE
SIDE GEAR
REMOVE
LOCKWIRE
AND
REMOVE
RETAINING RING
REMOVE
BEARING CONE

Figure 5-26. Transfer case power divider, back half, disassembled.

Note. Dip gears (6, 8, 10), bearings (1, 3, 5, 9) and shaft in light lube oil before reassembly.

5-22. Transfer Case Bushings, Bearing Cups, Gears and Oil Seals

a. General. Countershafts I through IV have bearing cups which can either be removed with the shaft assemblies or left in the transfer case for ready identification. The rear shift shaft oil seal must be replaced at overhaul. The crowd drive motor gear and bearing assembly can be removed at this time for convenience.

b. Disassembly.

(1) Turn transfer case rear half on side (fig. 5-45, 5-46).

(2) Disassemble miscellaneous parts in the numerical sequence as illustrated on figure 5-47.

(*a*) Attach bridge and puller to threaded hole in center plug of crowd drive gear (12).

(*b*) Pull gear and bearings (11, 13) toward outside rear of transfer case.

(*c*) Remove bearings from gear.

c. Cleaning. Clean all parts with approved cleaning solvent and dry with compressed air. Clean inside of case thoroughly.

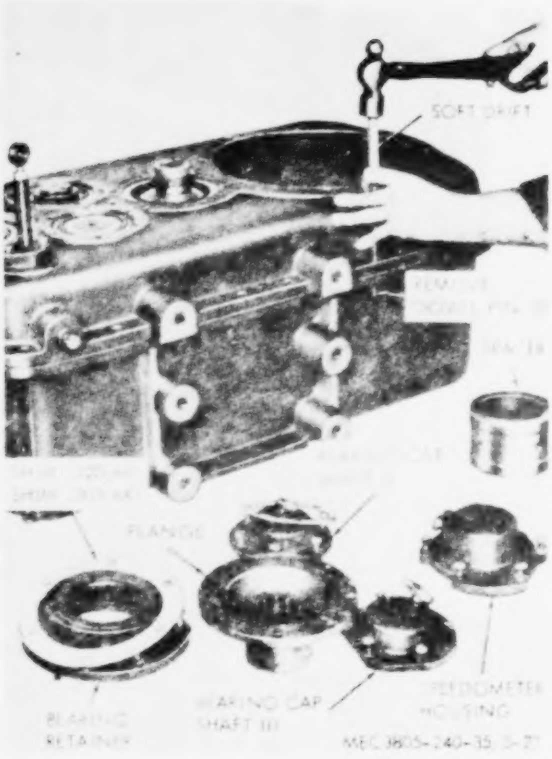

SOFT DRIFT
REMOVE
DOWEL PIN
FLANGE
BEARING
RETAINER
BEARING CAP
SHAFT III
SPEEDOMETER
HOUSING
MEC 3805-240-35 5-27

Figure 5-27. Transfer case bearing caps and dowel pin, removal.

d. Inspection and Repair.

(1) Replace oil seal.

(2) Inspect all bearing cups (1, 5, 7, 9) for wear, pitting and roughness. Replace defective cups.

(3) Inspect ball bearings (11, 13) for roughness, wear and pitting. Replace defective ball bearings.

(4) Inspect crowd drive motor gear (12) for cracks, breaks, pitting and gouges. Remove burrs and minor gouges with a hone. Replace defective gear.

(5) Replace retaining ring (10).

(6) Inspect transfer case halves for cracks, breaks, gouges and wear. Weld cracks if possible. *Replace defective halves as a unit.*

e. Reassembly. Reassemble and install crowd drive motor gear and bearings, bearing cups, oil seals and bushings in reverse of numerical sequence as illustrated on figure 5-47.

(1) Dip all parts in light lube oil before reassembly.

(2) Press bearing cups in place solidly.

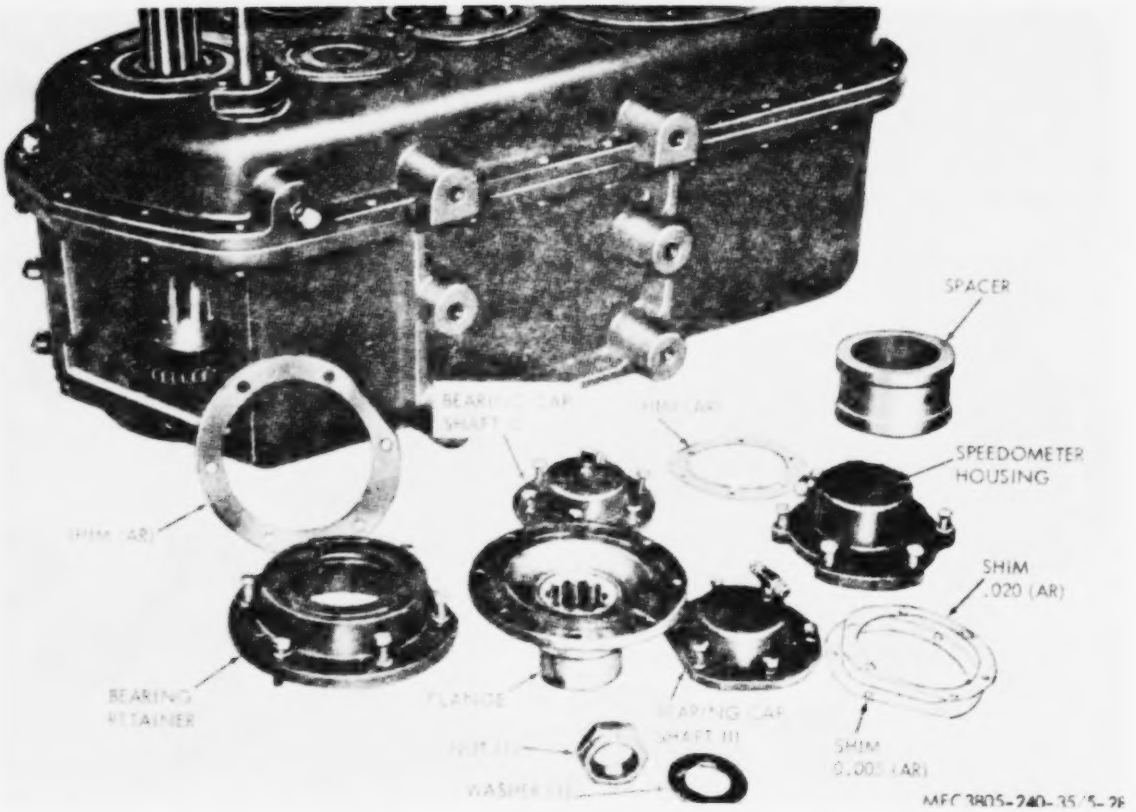

SPACER
SPEEDOMETER HOUSING
SHIM (AR)
BEARING CAP SHAFT II
SHIM (AR)
SHIM .020 (AR)
BEARING RETAINER
FLANGE
BEARING CAP SHAFT III
NUT III
WASHER III
SHIM 0.005 (AR)
MEC 3805-240-35/5-28

Figure 5-28. Transfer case front bearing caps, flange and spacer assemblies.

5-23. Transfer Case Installation

Refer to paragraph 2-48 and install the crowd drive motor on the transfer case. Refer to paragraph 2-42 and install the transfer case assembly on the ditching machine.

Caution: **Install the lube oil pump and tube assemblies *after* the transfer case has been installed in the ditching machine.**

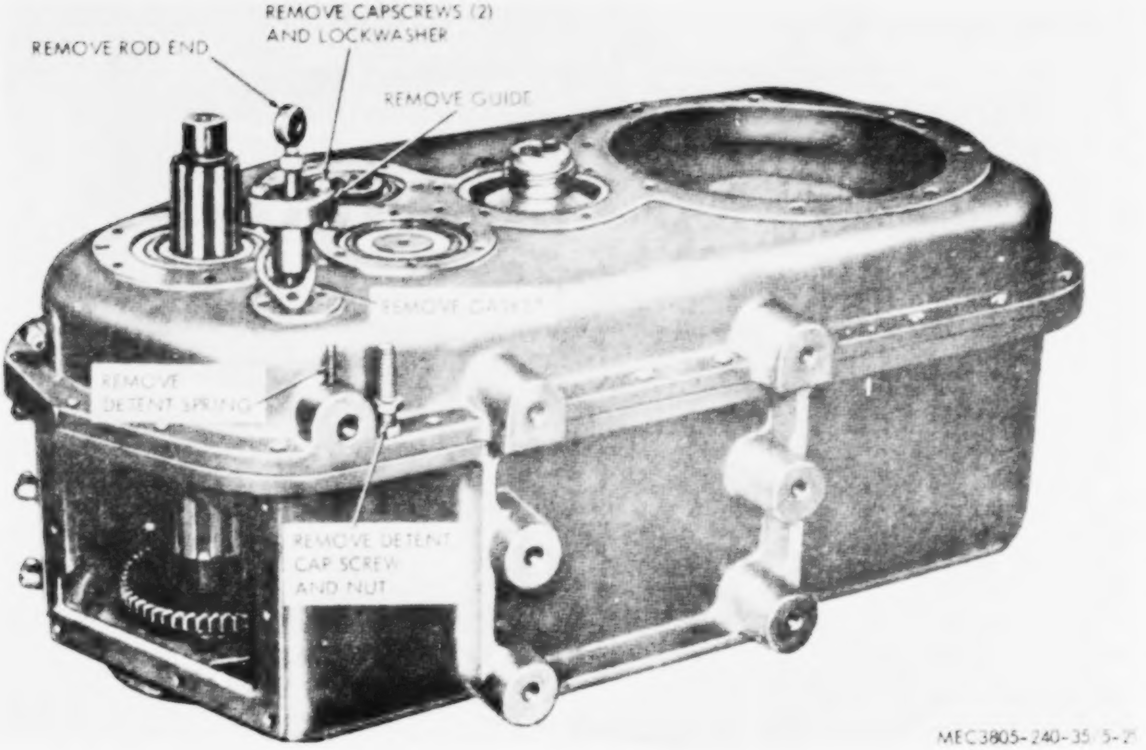
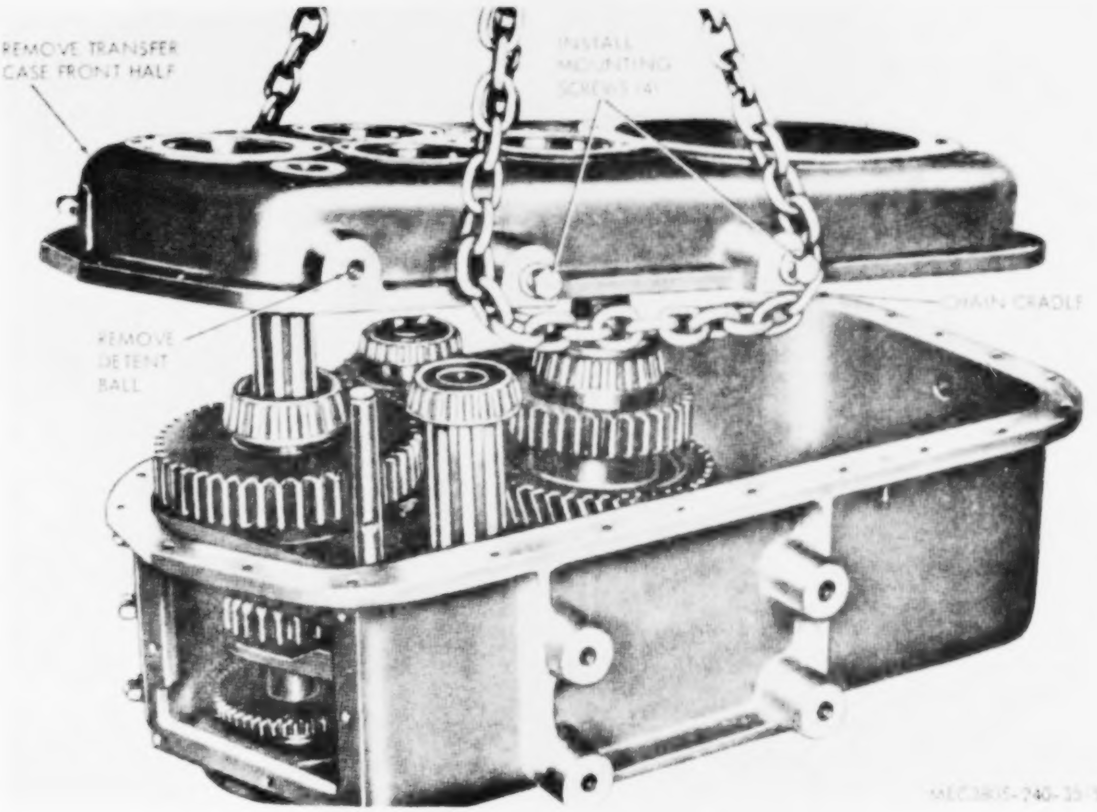
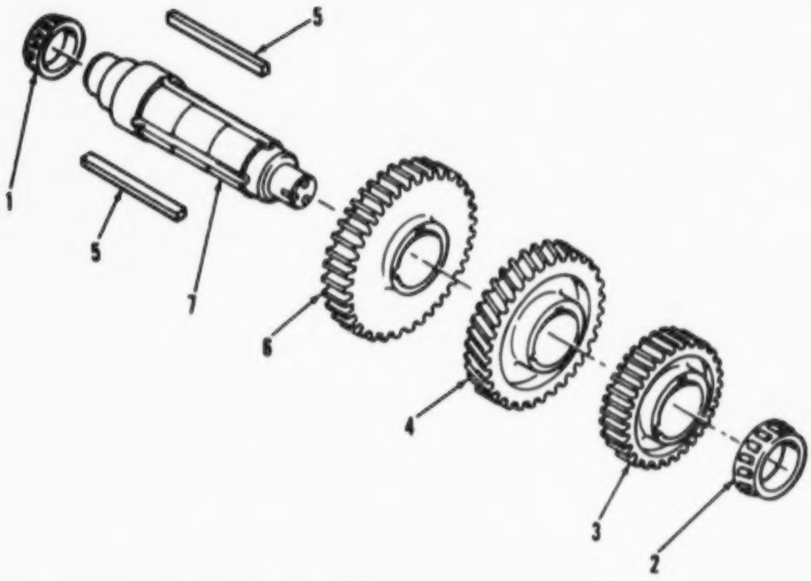

REMOVE CAPSCREWS (2) AND LOCKWASHER
REMOVE ROD END
REMOVE GUIDE
REMOVE GASKET
REMOVE DETENT SPRING
REMOVE DETENT CAP SCREW AND NUT
MEC3805-240-35 (5-29)

Figure 5-29. Transfer case shift rod end detent assembly.


REMOVE TRANSFER CASE FRONT HALF
INSTALL MOUNTING SCREWS (4)
CHAIN CRADLE
REMOVE DETENT BALL

MEC 3805-240-35/5-30

Figure 5-30. Transfer case front half, removal.



MEC3805-240-35/5-31

1 Cone, bearing	5 Key (2 rqr)
2 Cone, bearing	6 Gear, spur, 59T
3 Gear, spur, 35T	7 Countershaft IV
4 Gear, helical, 45T	

Figure 5-31. Transfer case countershaft IV, exploded view.

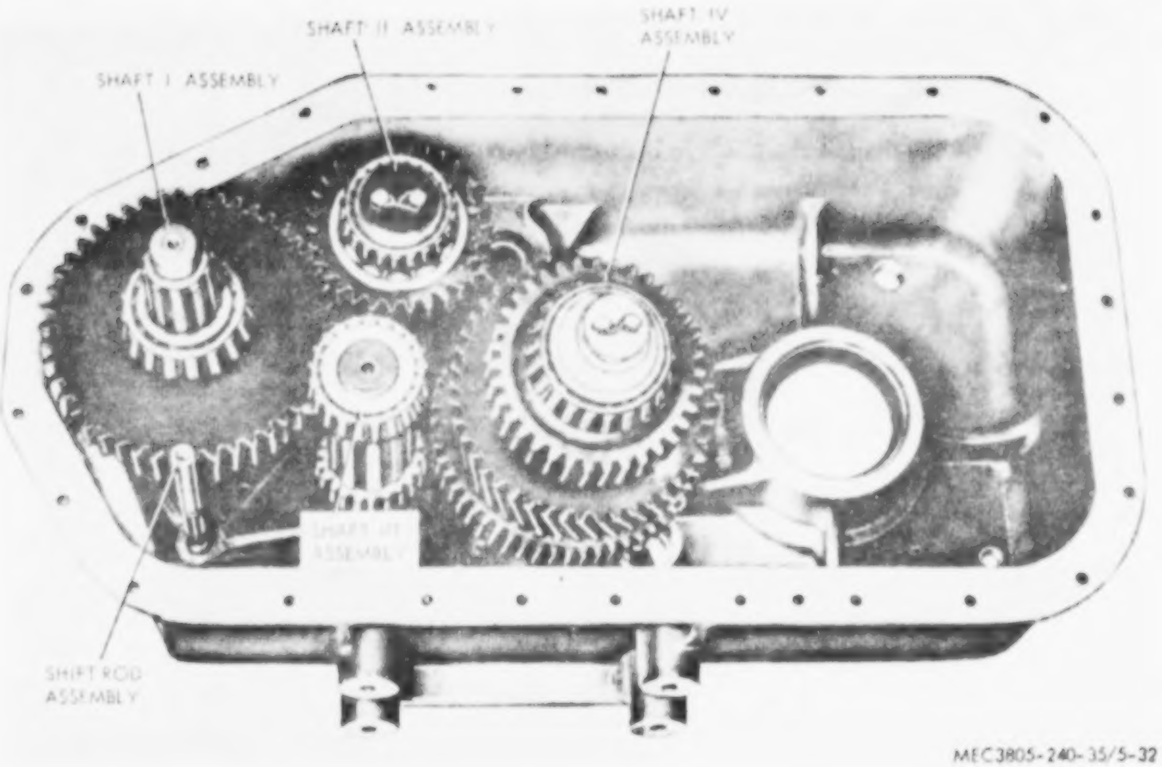
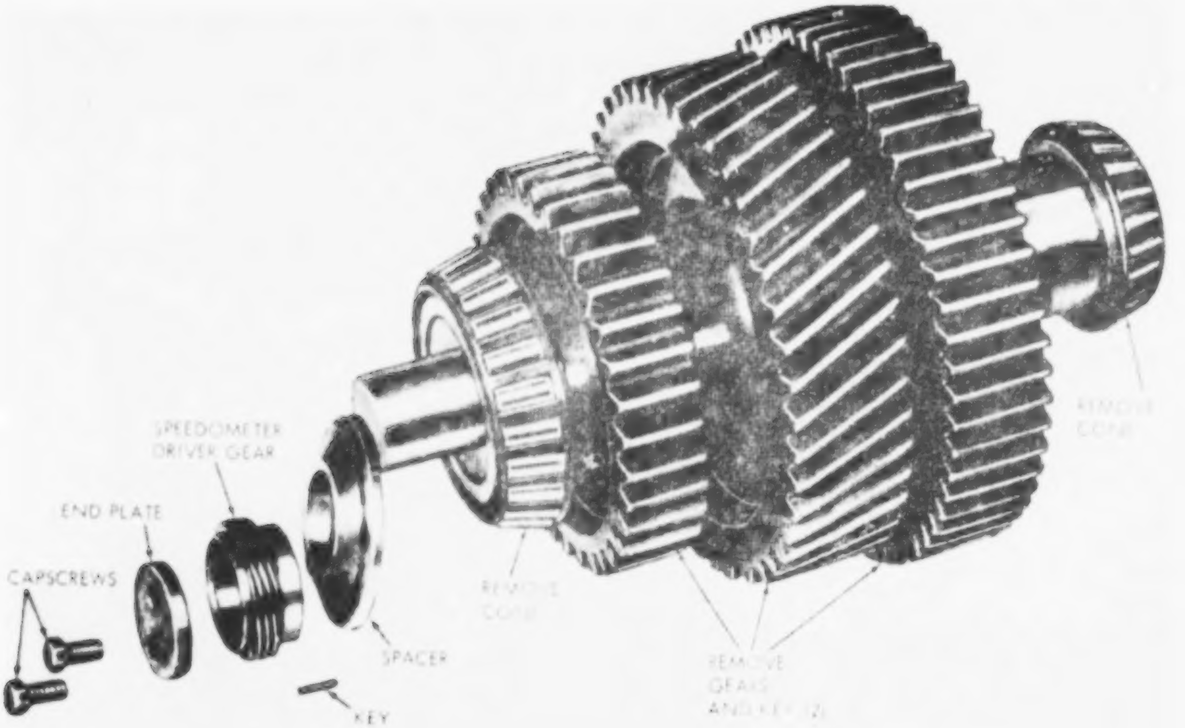
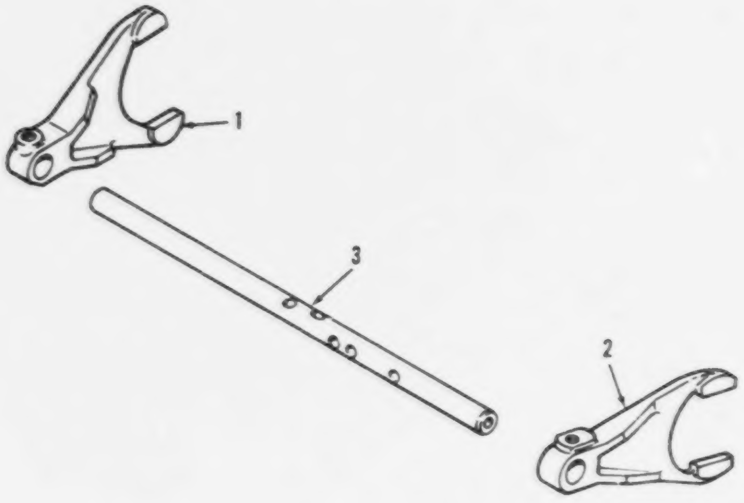

SHAFT II ASSEMBLY
SHAFT IV ASSEMBLY
SHAFT I ASSEMBLY
SHAFT III ASSEMBLY
SHIFT ROD ASSEMBLY
MEC3805-240-35/5-32

Figure 5-32. Transfer case countershaft assemblies.


SPEEDOMETER DRIVER GEAR
END PLATE
CAPSCREWS
SPACER
KEY
REMOVE CONE
REMOVE GEARS AND KEY (2)
REMOVE CONE

MEC3805-240-35/5-3

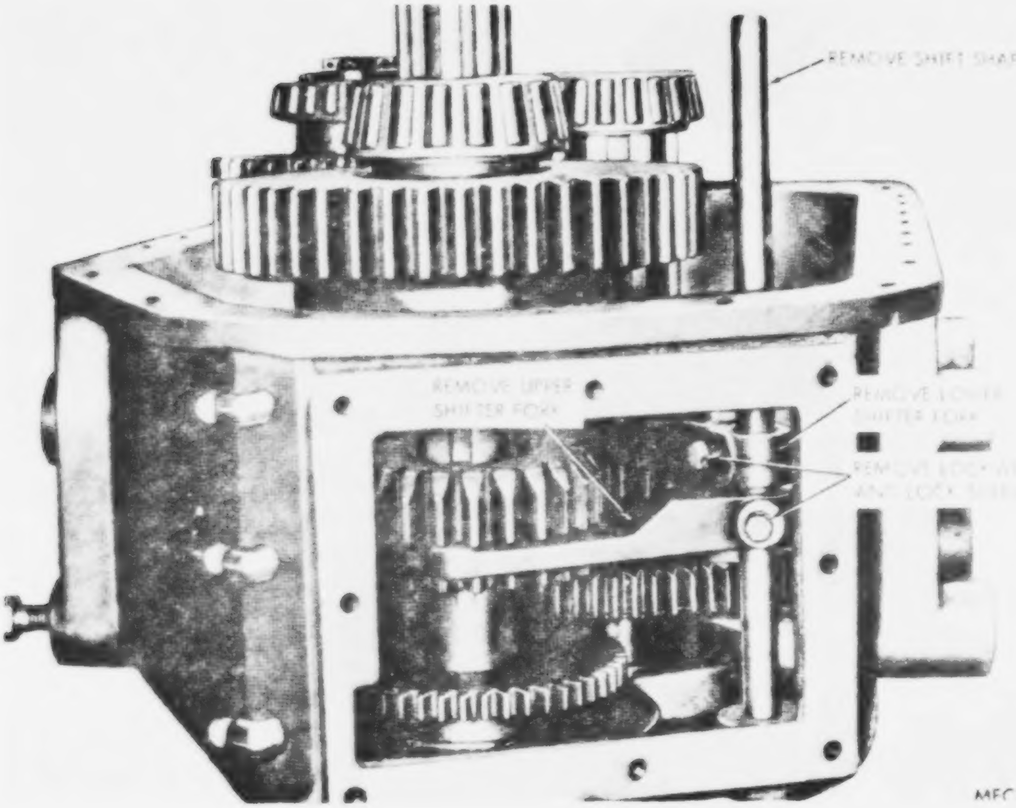
Figure 5-33. Transfer case countershaft assembly IV.



MEC3805-240-35/5-34

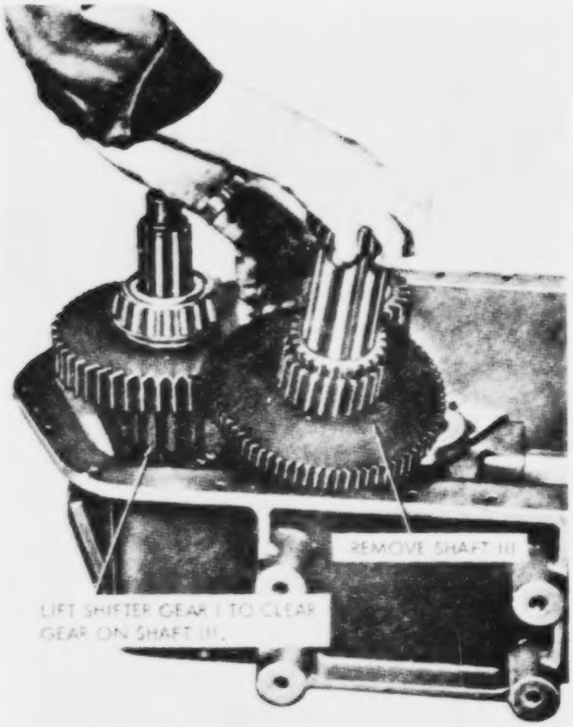
1 Selector fork, upper
2 Selector fork, lower
3 Shaft, gearshift

Figure 5-34. Transfer case shift shaft assembly, exploded view.


REMOVE SHIFT SHAFT
REMOVE UPPER SHIFTER FORK
REMOVE LOWER SHIFTER FORK
REMOVE LOCKWIRE AND LOCK SCREWS (2)

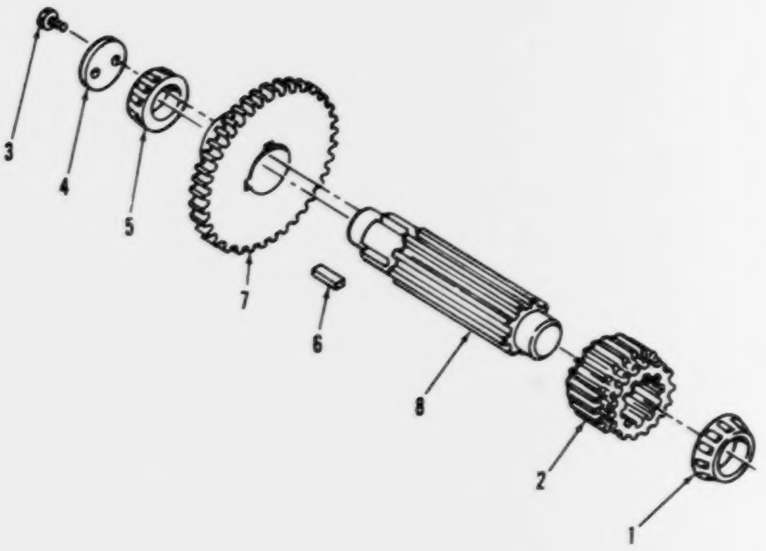
MEC 3805-240-35/5-35

Figure 5-35. Transfer case gear and shift shaft assembly.


REMOVE SHAFT III
LIFT SHIFTER GEAR I TO CLEAR GEAR ON SHAFT III.

MFC3805-240-35/5-36

Figure 5–36. Transfer case countershaft III, removal.



MEC3805-240-35/5-37

1 Cone, bearing
2 Gear, sliding, 23T
3 Screw, cap, 3/8-24 x 1 in. (2 rqr)
4 Cap, end
5 Cone, bearing
6 Key
7 Gear, spur, 74T
8 Countershaft III

Figure 5-37. Transfer case countershaft III assembly, exploded view.

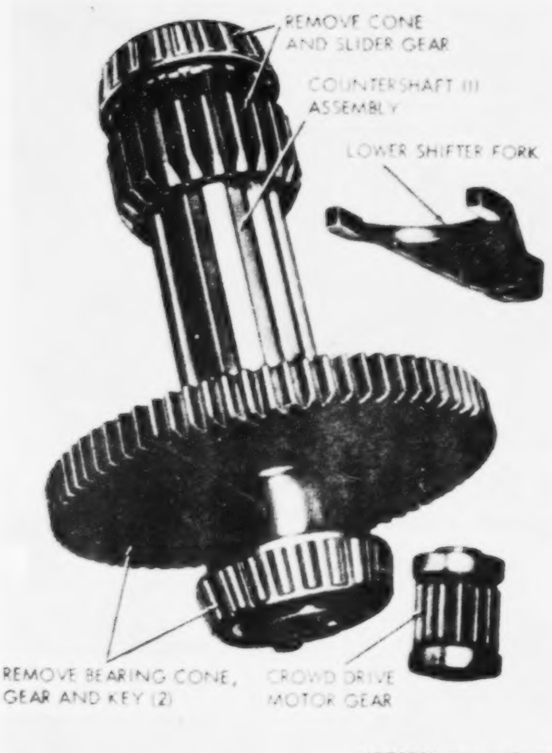
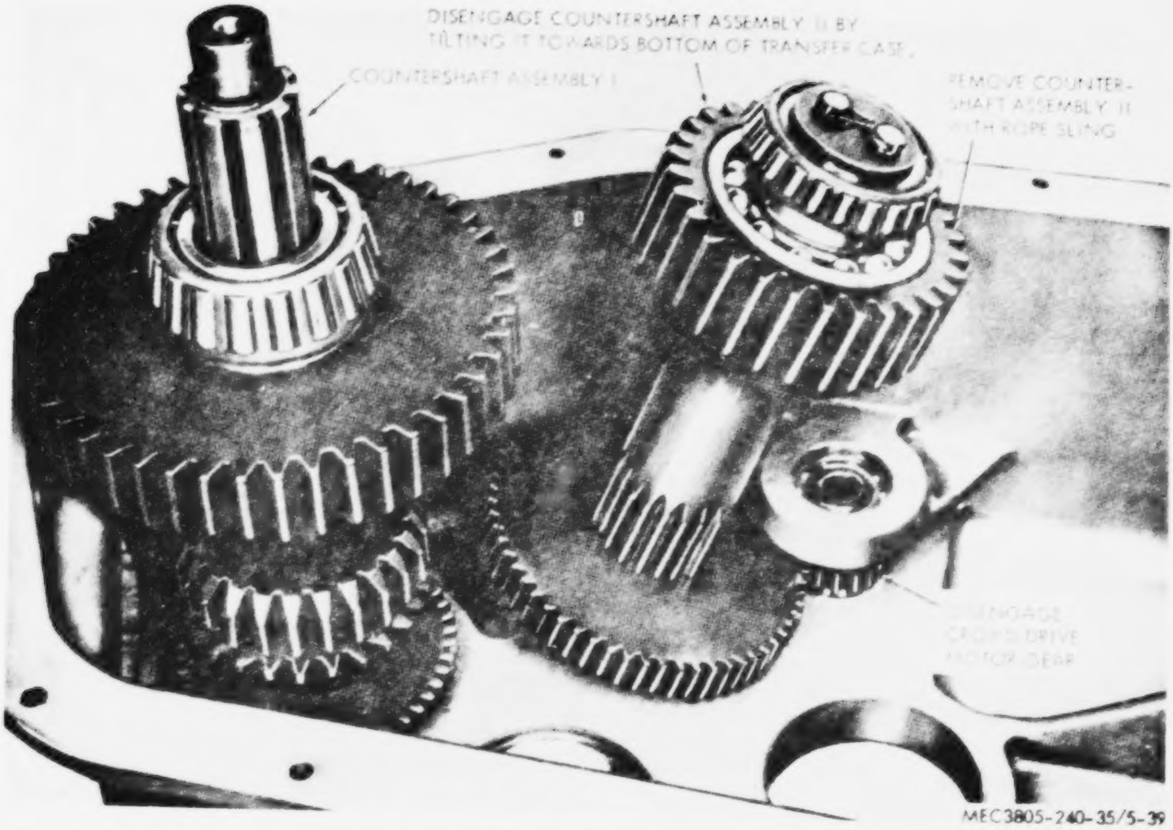
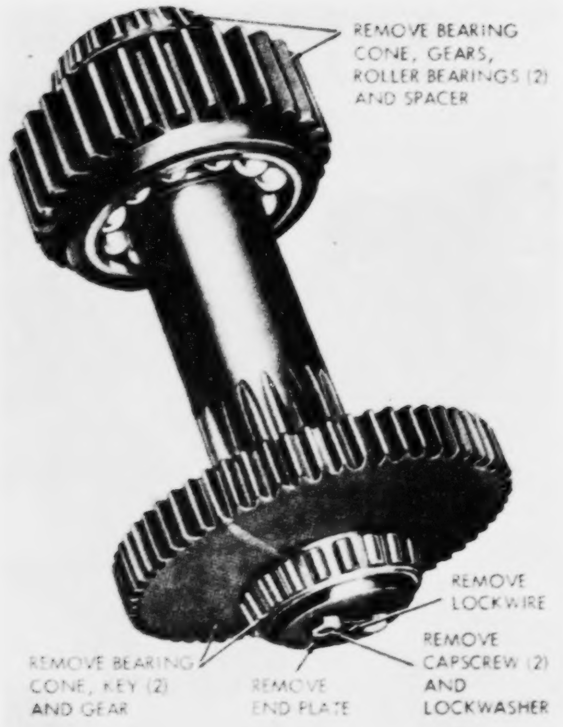

REMOVE CONE AND SLIDER GEAR
COUNTERSHAFT III ASSEMBLY
LOWER SHIFTER FORK
REMOVE BEARING CONE, GEAR AND KEY (2)
CROWD DRIVE MOTOR GEAR
MEC3805-240-35/5-38

Figure 5-38. Countershaft III assembly and miscellaneous parts.


DISENGAGE COUNTERSHAFT ASSEMBLY II BY TILTING IT TOWARDS BOTTOM OF TRANSFER CASE.
COUNTERSHAFT ASSEMBLY I
REMOVE COUNTERSHAFT ASSEMBLY II WITH ROPE SLING
DISENGAGE CROWD DRIVE MOTOR GEAR

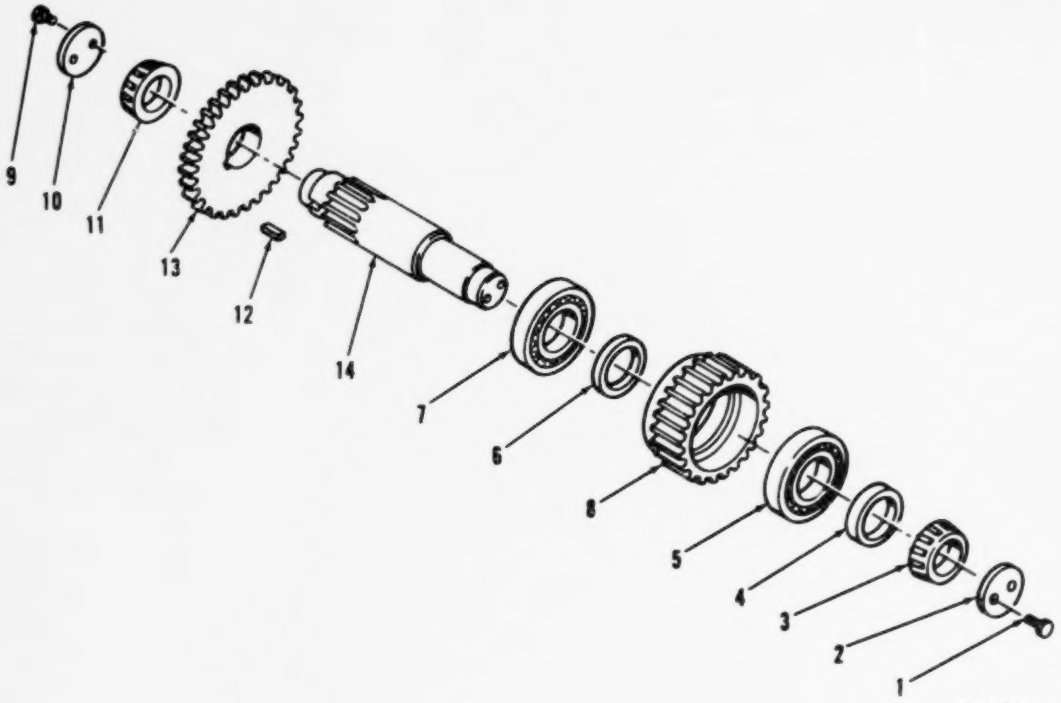
MEC3805-240-35/5-39

Figure 5-39. Transfer case countershaft II assembly, removal.


REMOVE BEARING CONE, GEARS, ROLLER BEARINGS (2) AND SPACER
REMOVE LOCKWIRE
REMOVE CAPSCREW (2) AND LOCKWASHER
REMOVE BEARING CONE, KEY (2) AND GEAR
REMOVE END PLATE

MEC3805-240-35/5-40

Figure 5-40. Transfer case countershaft II assembly.


9
10
11
13
12
14
7
6
8
5
4
3
2
1
MEC3805-240-35/5-41

1	Screw, cap, 3/8-24 x 1 in. (2 rqr)
2	Cap, end
3	Cone, bearing
*4	Spacer
*5	Bearing, ball
*6	Spacer
*7	Bearing, ball
*8	Gear, idler, 30T
9	Screw, cap, 3/8-24 x 1 in. (2 rqr)
10	Plate, end
11	Cone, bearing
12	Key
13	Gear, spur, 59T
14	Shaft, slide

*Bearing and spacers removed after gear removal from shaft.

Figure 5-41. Transfer case countershaft I assembly, exploded view.

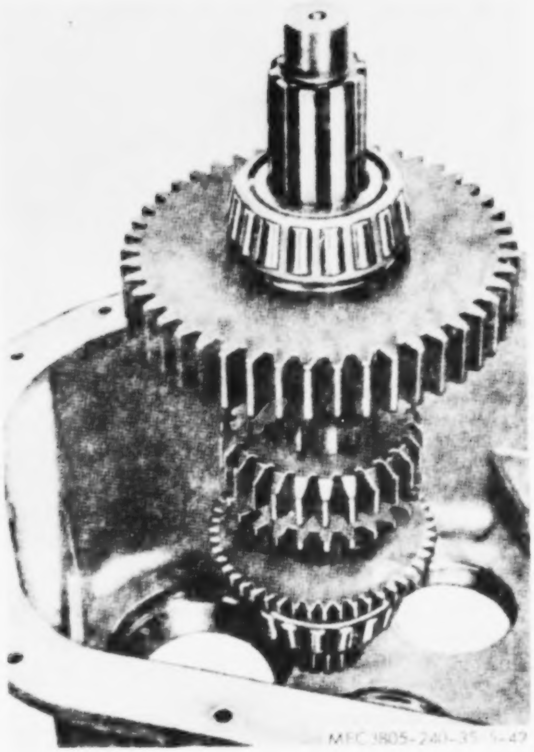
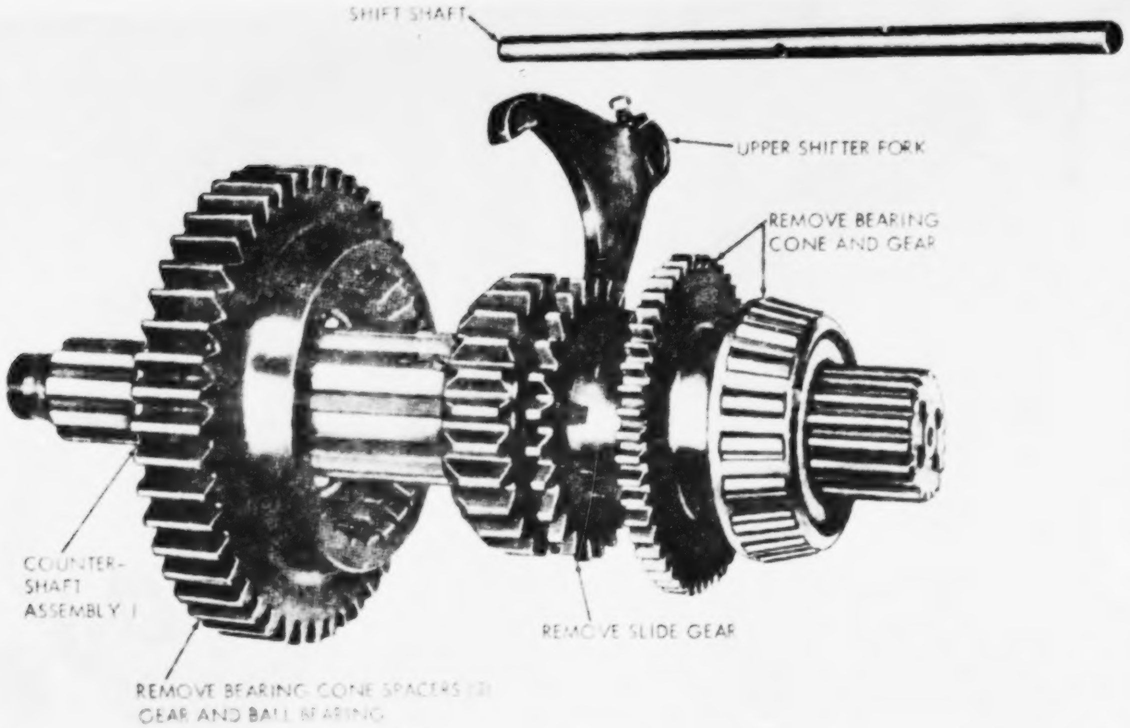
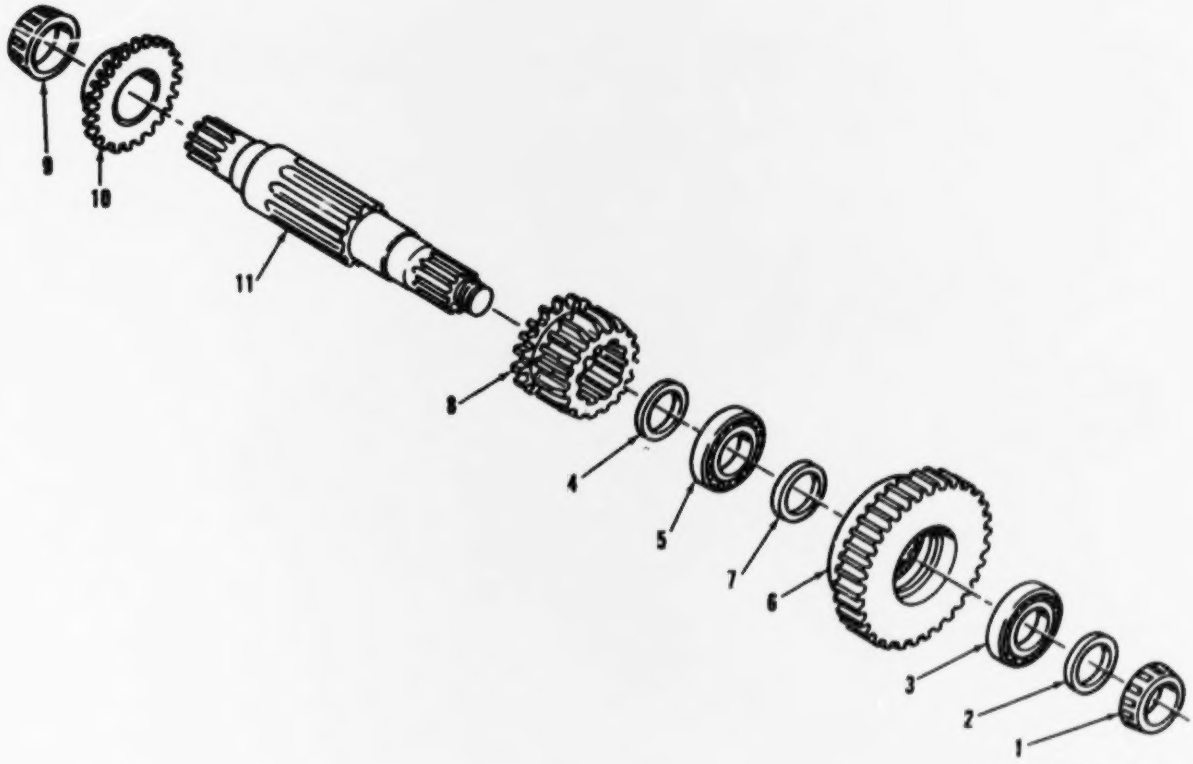

MEC 3805-240-35 5-42

Figure 5-42. Transfer case countershaft I, removal.


SHIFT SHAFT
UPPER SHIFTER FORK
REMOVE BEARING CONE AND GEAR
COUNTER-SHAFT ASSEMBLY I
REMOVE SLIDE GEAR
REMOVE BEARING CONE SPACERS (2) GEAR AND BALL BEARING

MEC3805-240-35/5-43

Figure 5-43. Transfer case countershaft I and shift shaft assembly.



MEC3805-240-35/5-44

1 Cone, bearing
2 Spacer
*3 Bearing, ball
*4 Spacer
*5 Bearing, ball
*6 Gear, spur, 46T
7 Spacer
8 Gear, spur, sliding, 25T
9 Cone, bearing
10 Gear, lube oil pump drive
11 Countershaft I.

*The bearings and spacer removed from gear after removal of gear from shaft.

Figure 5-44. Transfer case countershaft I assembly, exploded view.

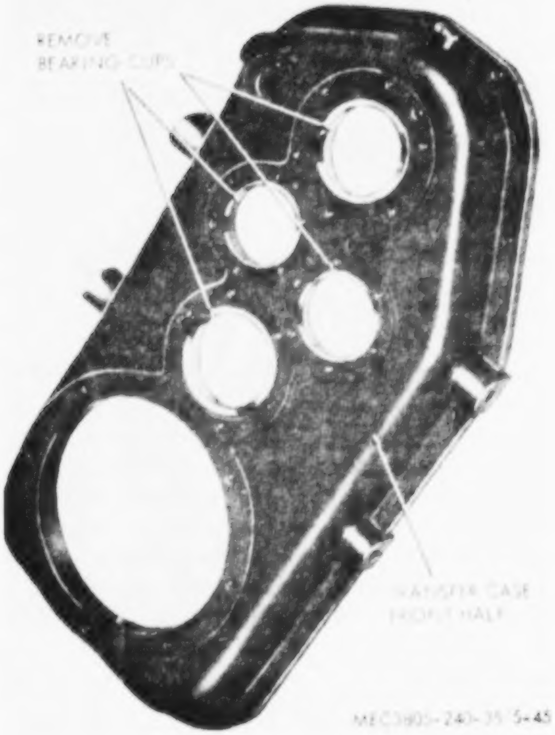

REMOVE
BEARING CUPS
TRANSFER CASE
FRONT HALF
MEC3805-240-35/5-45

Figure 5-45. Transfer case front half, with bearing cups.

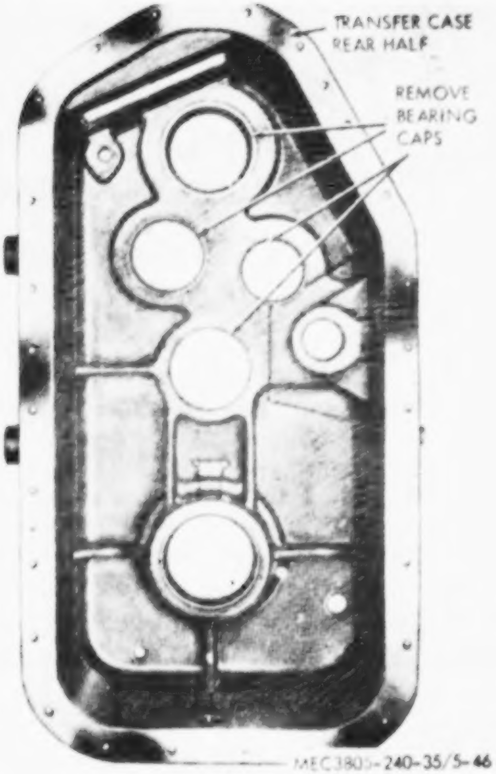
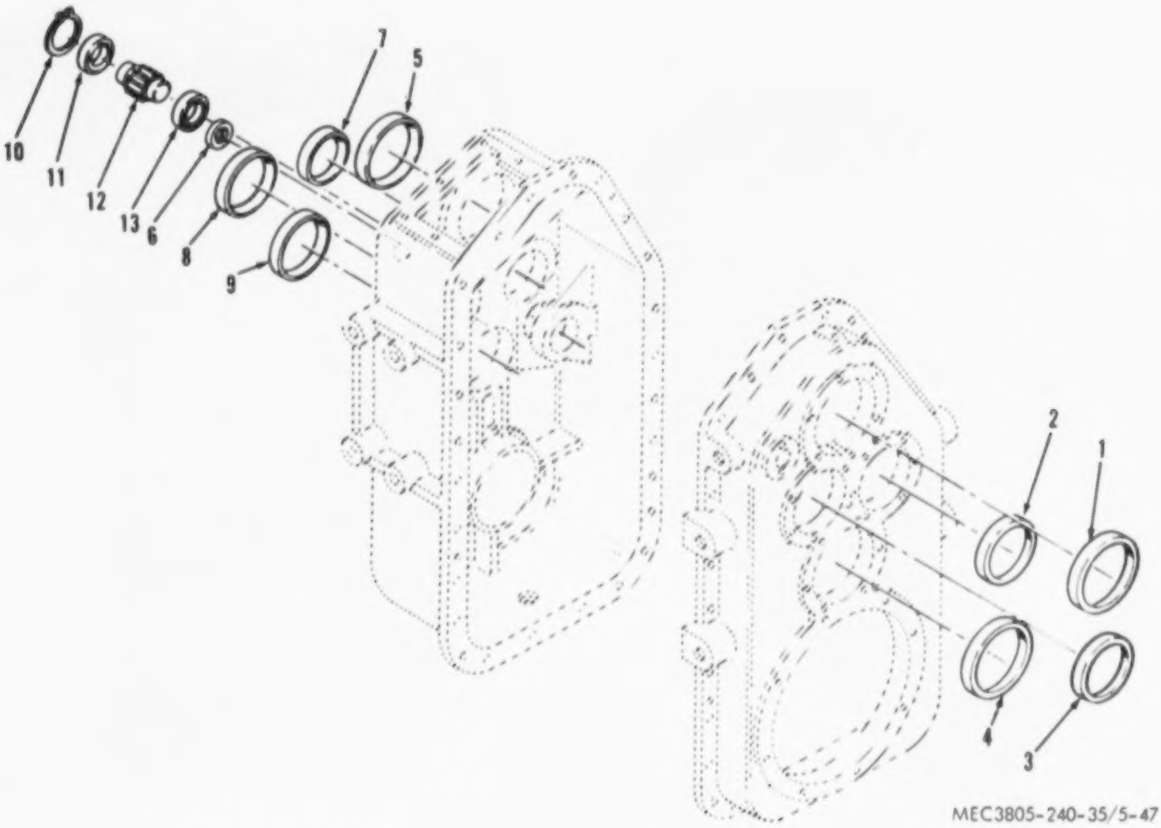

TRANSFER CASE
REAR HALF
REMOVE
BEARING
CAPS
MEC3805-240-35/5-46

Figure 5-46. Transfer case rear half and bearing cups.



1	Cup, front bearing, countershaft I
2	Cup, front bearing, countershaft II
3	Cup, front bearing, counter shaft III
4	Cup, front bearing, countershaft IV
5	Cup, rear bearing, countershaft I
6	Seal, oil, shift assembly
7	Cup, rear bearing, countershaft II
8	Cup, rear bearing, countershaft III
9	Cup, rear bearing, countershaft IV
10	Ring, retaining
11	Bearing, ball
12	Gear, spur, 16T
13	Bearing, ball

Figure 5-47. Transfer case bearing cups, crowd drive motor gear and bearings, and miscellaneous parts, exploded view.

CHAPTER 6

FRONT AND REAR AXLE ASSEMBLIES AND RIGHT-ANGLE SPROCKET DRIVE ASSEMBLY

Section I. GENERAL

6-1. Description

The front and rear axle planetary systems receive power from the propeller shafts through differential assemblies mounted in the axle housings. The differentiating action compensates for the difference between the speed of an outside wheel and the speed of an inside wheel when the ditcher is turning. The matched pinion and ring-gear set in each differential brings about a gear reduction. A sun gear and three planet gears in each wheel hub create a further gear reduction. Ball-and-socket assemblies on the front axle allow the front wheels to be steered. The right-angle drive receives power from a propeller shaft running from the transfer case to the differential, where a gear reduction occurs. The power is transmitted to wheel sprockets, which engage drive chains and operate the bucket line.

Section II. FRONT PLANETARIES

Note. The two ends of the front planetary system are not identical: some of the parts used on the right side will not fit on the left. When disassembling the front axle assembly, keep parts from each side separate.

6-2. Disassembly

a. Removal. Refer to paragraph 2-46 and remove the front axle assembly from the ditcher. Move the axle assembly to a suitable work area. Refer to TM 5-3805-240-12 and remove the wheels. Replace the back nuts and wheel nuts before disassembling the axle in the numerical order shown in figure 6-1.

Note. Before disassembling the planetary systems, drain the entire front axle assembly by removing the drain plug (121) at the bottom of the wheel hub and the drain plug (122) at the bottom-center of the axle housing. When all fluid has drained off, screw the drain plugs back into the proper holes.

b. Remove six capscrews (4) and lockwashers (5) from cover plate (6) and remove cover plate with thrust button (7) as an assembly. Refer to *a*, paragraph 6-4, for thrust-button removal instructions. Remove gasket (8), sun-gear snap rings (9), sun gear (10) and thrust washer (11) (fig. 6-2, 6-3).

Note. Parts 1, 2 and 3 were removed during removal of the axle assembly from the ditcher.

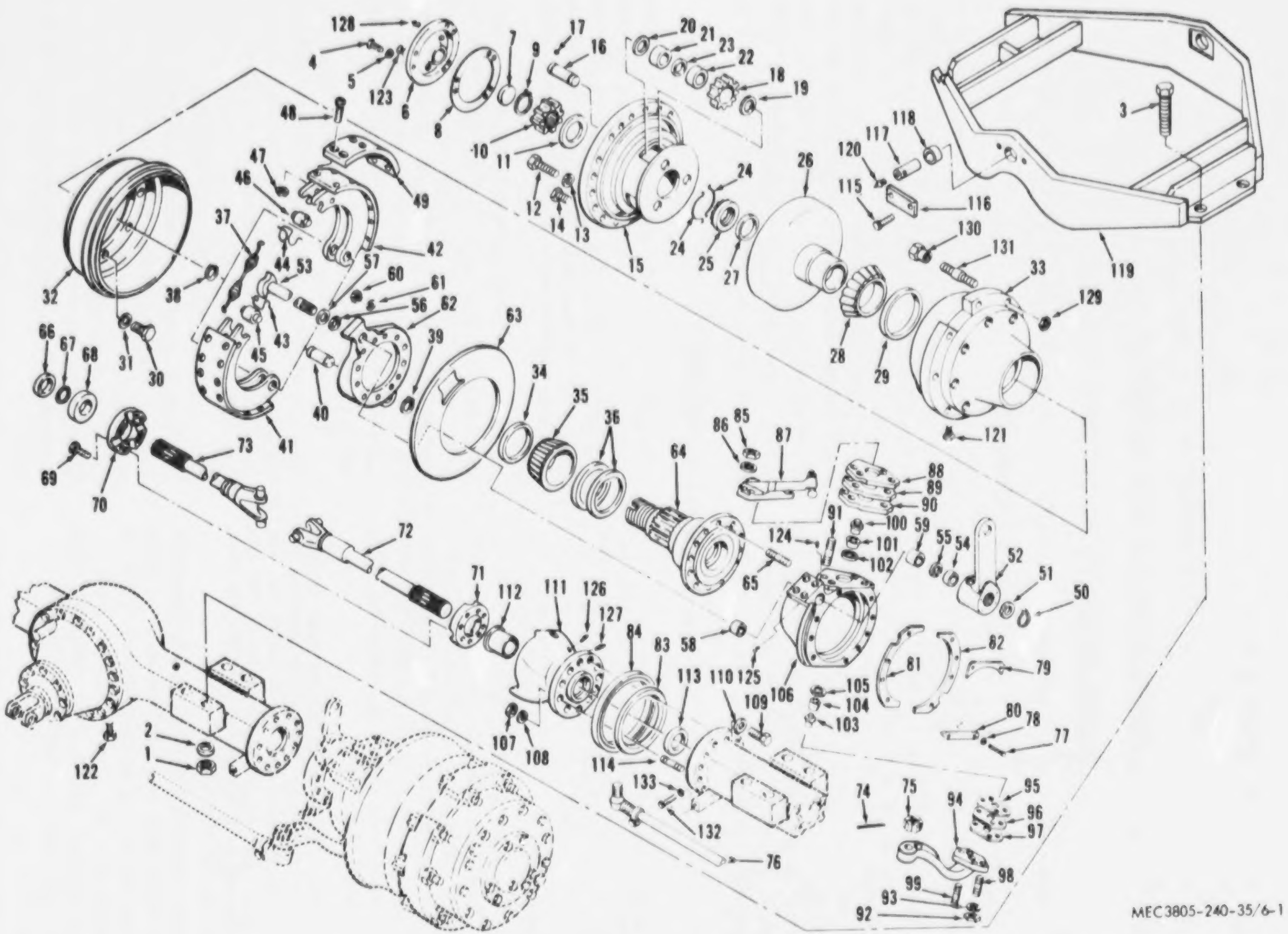
c. Remove 12 capscrews (12) and lockwashers (13) and the two puller-hole capscrews (14) from the planetary spider (15). Insert two of the long capscrews in the puller holes and turn alternately—one turn at a time—until spider breaks free of plastic gasket. Remove spider assembly (fig. 6-4).

d. From inside spider, strike planet-gear pins (16) outward. The three pin balls (17) will fall to the floor. Remove the planet gears (18) and the inner and outer planet-gear thrust washers (19, 20). From the inside of the planet gears remove the inner and outer roller bearings (21, 22) and the bearing spacer (23).

e. Remove the two skein lock-nut clips (24) with a screwdriver and remove the skein lock nut (25), using the manufacturer's special wrench (table 2-1) (fig. 6-5). Remove ring gear (26) and skein bushing (27) (fig. 6-6). Remove skein bearing cones (28) and cup (29).

f. Attach a hoist of suitable capacity to the hub-and-drum assembly (30 through 33) (fig. 6-7). Strike the assembly from side to side to free it from its bearings, then remove by pulling outward. Remove eight capscrews (30) and lockwashers (31) and separate drum (32) from hub (33).

g. Remove inner skein bearing cup (34) and cones (35) from skein. Remove the two skein oil seals (36).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74
75
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97
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2
1
MEC3805-240-35/6-1

1 Nut, 1–8 (8 rqr)
2 Lockwasher, 1 in. (8 rqr)
3 Machine bolt, 1–8 x 5 1/2 in. (8 rqr)
4 Capscrew, 7/16–20 x 1 1/4 in. (6 rqr)
5 Lockwasher, 7/16 in. (6 rqr)
6 Cover plate

Figure 6–1. Front steering axle and brake assembly, exploded view.

7	Thrust button
8	Gasket
9	Sun-gear snap ring
10	Sun gear
11	Sun-gear thrust washer
12	Capscrew, 1/2-20 x 2 in. (12 rqr)
13	Lockwasher, 1/2 in. (12 rqr)
14	Puller-hole capscrew, 1/2-20 x 1/2 in. (2 rqr)
15	Planetary spider
16	Planetary gear pin (3 rqr)
17	Ball (3 rqr)
18	Planet gear (3rqr)
19	Inner planet-gear thrust washer (3 rqr)
20	Outer planet-gear thrust washer (3 rqr)
21	Outer planet-gear roller bearing (3 rqr)
22	Inner planet-gear roller bearing (3 rqr)
23	Planet-gear bearing spacer (3 rqr)
24	Skein lock-nut key (2 rqr)
25	Skein lock-nut
26	Ring-gear
27	Ring-gear bushing
28	Tapered roller-bearing cone
29	Tapered roller-bearing cup
30	Capscrew, 5/8-18 x 1.88 in. (8 rqr)
31	Lockwasher, 5/8 in. (8 rqr)
32	Brake drum
33	Wheel hub
34	Tapered roller-bearing cup
35	Tapered roller-bearing cone
36	Oil seal (2 rqr)
37	Brake-shoe return spring
38	Outer anchor-pin snap ring
39	Inner anchor-pin snap ring
40	Anchor pin
41	Trailing brake shoe
42	Leading brake shoe
43	Trailing brake-shoe roller spring
44	Leading brake-shoe roller spring
45	Trailing brake-shoe roller
46	Leading brake-shoe roller
47	Self-locking nut, 1/4-28 (48 rqr)
48	Flat-head slotted capscrew, 1/4-28 x 1 in. (48 rqr)
49	Brake lining (4 rqr)
51	Slack-adjuster spacer
52	Brake slack adjuster
53	Brake camshaft
54	Camshaft spacer
55	Inner oil seal
56	Outer oil seal
57	Camshaft washer
58	Outer nylon bushing
59	Inner nylon bushing
60	Brake spider nut, 1/2-20 (12 rqr)
61	Brake spider lockwasher, 1/2 in. (12 rqr)
62	Brake spider
63	Dust shield
64	Skein
65	Spider stud, 1/2 x 2.56 in. (12 rqr)
66	Oil seal
67	Snap ring
68	Ball bearing
69	Cage-ring screw, .497-20 x 2 3/16 in. (8 rqr)
70	Tapped cage ring
71	Drilled cage ring
72	Outer axle shaft
73	Inner axle shaft
74	Cotter pin
75	Castellated nut, 7/8-14
76	Tie-rod assembly
77	Capscrew, 5/16-24 x 1/2 in. (10 rqr)
78	Lockwasher, 5/16 in. (10 rqr)
79	Top seal-retainer connector
80	Bottom seal-retainer connector
81	Trailing retainer
82	Leading seal retainer
83	Pre-formed rubber packing
84	Oil seal
85	Nut, 3/4-18 (4 rqr)
86	Lockwasher, 3/4 in. (4 rqr)
87	Steering arm (left side only)
88	Shim, .005 in.
89	Shim, .010 in. } (as rqr)
90	Shim, .015 in.
91	Stud, 3/4-16 x 2.62 in. (4 rqr)
92	Nut, 3/4-16 (4 rqr)
93	Lockwasher, 3/4 in. (4-rqr)
94	Tie-rod arm
95	Shim, .005 in.
96	Shim, .010 in. } (as rqr)
97	Shim, .015 in.
98	Stud, 3/4-16 x 2.62 in. (3 rqr)
99	Stud, 3/4-16 x 3.60 in.
100	Top bearing pin
101	Tapered roller-bearing cone
102	Tapered roller-bearing cup
103	Bottom bearing pin
104	Tapered roller-bearing cone
105	Tapered roller-bearing cup
106	Socket
107	Nut, 5/8-18 (9 rqr)
108	Lockwasher, 5/8 in. (9 rqr)
109	Capscrew, 3/4-16 x 1 3/4 in. (2 rqr)
110	Lockwasher, 3/4 in. (2 rqr)
111	Ball
112	Bushing
113	Oil seal
114	Stud, 5/8-18 x 2.62 in. (9 rqr)
115	Capscrew, 1/2-13 x 1 in. (4 rqr)
116	Retaining plate
117	Grooved pin
118	Sleeve bearing
119	Trunnion
120	Grease fitting
121	Magnetic drain plug, 1/2 in. NPT
122	Magnetic drain plug, 3/4 in. NPT
123	Magnetic level and filler plug, 3/4 in. NPT
124	Relief fitting
125	Relief fitting
126	Grease fitting
127	Grease fitting
128	Relief fitting
129	Back nut, 1-14 (10 rqr)
130	Wheel nut, 1 1/8-16 (10 rqr)
131	Wheel stud (10 rqr)
132	Steering-stop capscrew, 5/8-18 x 2 3/4 in. (2 rqr)
133	Steering-stop nut, 5/8-18 (2 rqr)

Figure 6-1—Continued

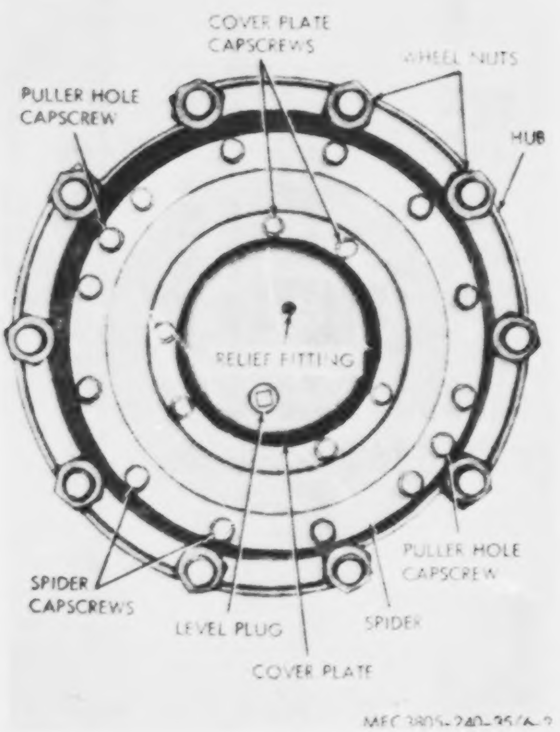

COVER PLATE CAPSCREWS
WHEEL NUTS
PULLER HOLE CAPSCREW
HUB
RELIEF FITTING
PULLER HOLE CAPSCREW
SPIDER CAPSCREWS
LEVEL PLUG
SPIDER
COVER PLATE
MEC 3805-240-35/6-2

Figure 6-2. Planetary before disassembly.

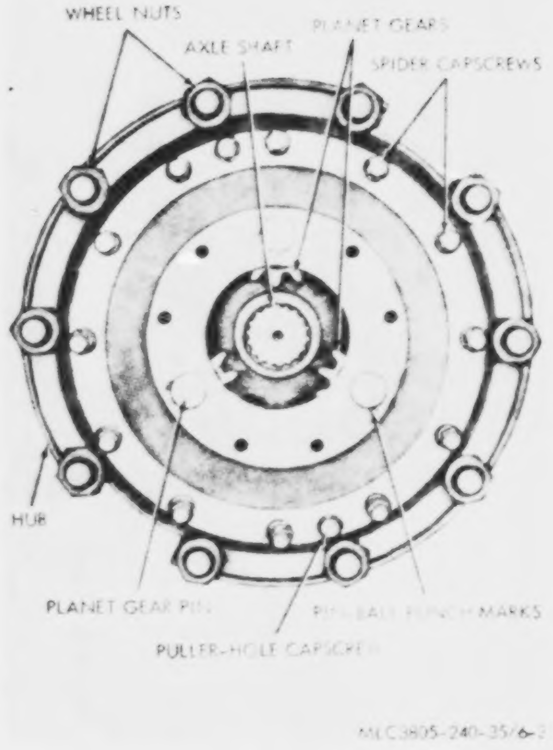

WHEEL NUTS
PLANET GEARS
AXLE SHAFT
SPIDER CAPSCREWS
HUB
PLANET GEAR PIN
PIN BALL PUNCH MARKS
PULLER-HOLE CAPSCREW
MEC 3805-240-35/6-3

Figure 6-3. Removing cover plate and sun gear.

h. Using a brake-spring pliers, remove the brake-return spring (37) from the brake-shoe assemblies. Remove the outer brake-shoe anchor-pin snap ring (38) with a screwdriver. Knock the pin inward and remove the inner snap ring (39) with a screwdriver. Remove the anchor pin (40) and both brake-shoe assemblies (41, 42). Remove both brake-shoe roller springs (43, 44) and both rollers (45, 46). Remove 24 self-locking nuts (47) from the back of each brake shoe and 24 flat-head screws (48) from the face of each shoe. Remove two brake linings (49) from each shoe (fig. 6-8 and 6-9).

i. Remove brake slack-adjuster snap ring (50), spacer (51) and slack adjuster (52). Remove brake camshaft (53), camshaft spacer (54) and inner seal (55). Remove outer seal (56) and washer (57).

Note. At this point the two nylon camshaft bushings (58, 59) may be removed from the camshaft passage in the socket. The bushings need not be removed unless found to be damaged. However, once removed, they must be replaced, as removal damages them. Refer to *f*, paragraph 6-4, for instructions concerning the inspection, removal and replacement of these parts.

j. Remove 12 nuts (60) and lockwashers (61) and remove brake spider (62) and dust shield (63). Tap the skein (64) with a bronze hammer to loosen it. Remove skein and 12 studs (65). Remove oil seal (66), snap ring (67) and ball bearing (68) from axle shaft.

k. Remove axle-shaft assembly (69 through 73) as a unit. Refer to *b*, paragraph 6-4, for instructions concerning the inspection, repair and reassembly of the axle-shaft assembly.

l. Remove the cotter pin (74) and castellated nut (75) from tie-rod arm (94) and invert the nut on top of the ball-stud in the tie-rod assembly (76). Strike the nut sharply and drive the ball-stud taper out of the tie-rod arm. Repeat on the other side of the axle assembly and remove tie-rod assembly from axle. Remove 10 capscrews (77) and lockwashers (78) and remove the top and bottom seal-retainer connectors (79, 80) and the seal retainer strips (81, 82). Remove the oil seal packing (83) and discard. Remove the oil seal (84) and let it hang on the neck of the ball until it can be removed from the axle housing (fig. 6-10, 6-11).

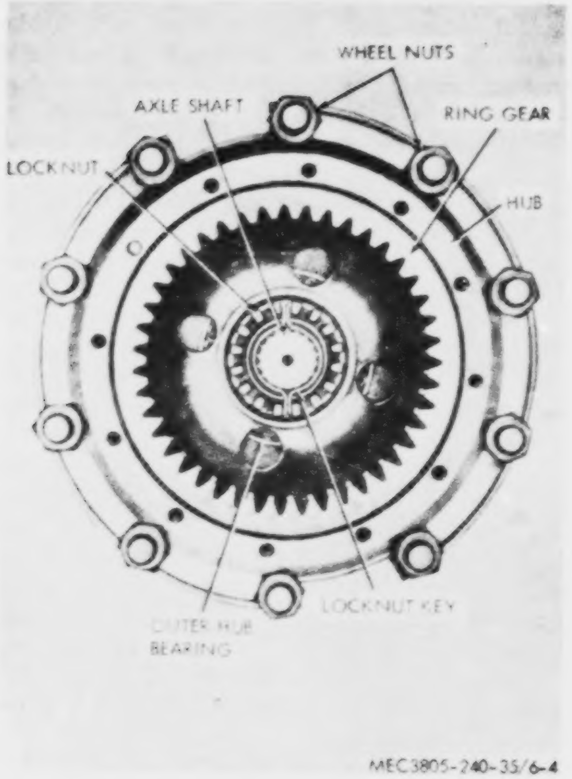


Figure 6-4. Planetary spider removal.

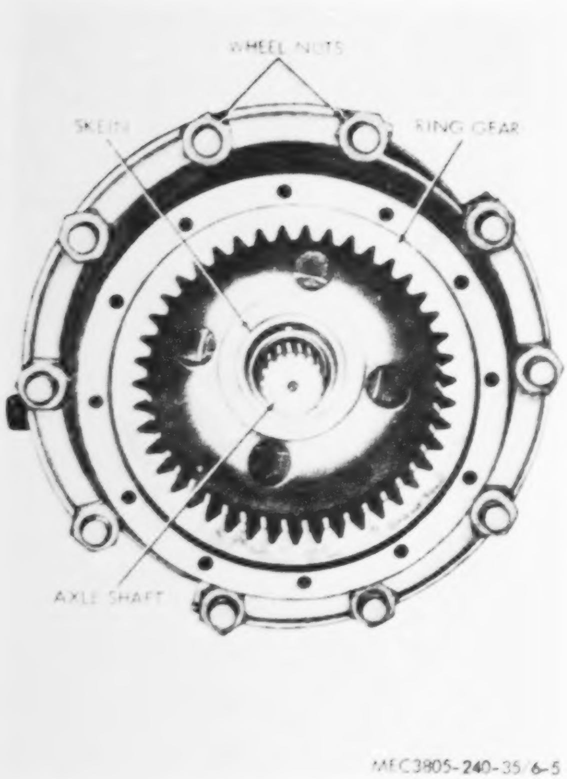


Figure 6-5. Skein lock-nut removal.

m. Remove four nuts (85) and lockwashers (86) and remove steering arm (87).

Note. The steering arm occurs on the left side only; on the right side the socket bearing is covered by a bearing cap not shown in figure 6-1. The bearing cap is secured by the same number and size of nuts, lockwashers and studs as the steering arm and is removed in the same manner.

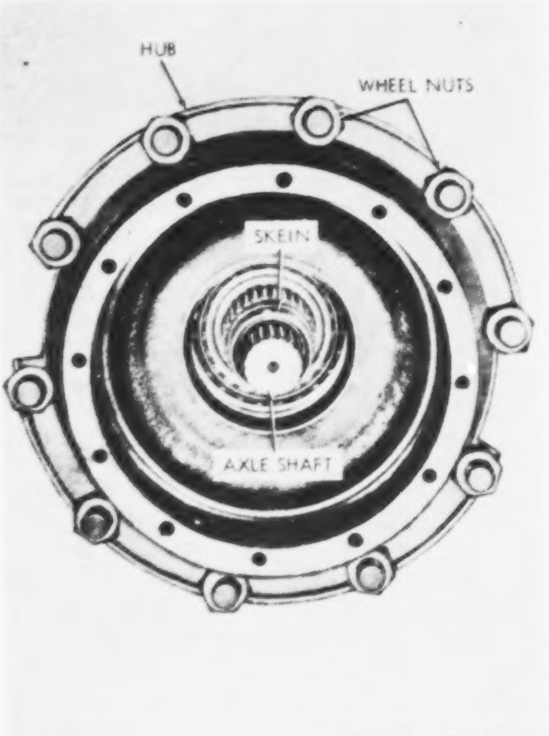
n. Remove shims (88, 89, 90) and note the number and thickness of shims present. Remove four studs (91) from top of socket assembly. Remove four nuts (92) and lockwashers (93) from bottom of socket assembly and remove tie-rod arm (94). Remove shims (95, 96, 97) and note the number and thickness of shims present. Remove the three short studs (98) and one long stud (99) from bottom of socket assembly (fig. 6-12).

Note. Socket shims are furnished in three thicknesses to be used as required.

o. Drive top bearing pin (100) up and out of socket from inside of ball. Remove top bearing cone (101) and cup (102). Drive bottom bearing pin (103) out of socket from inside of ball and remove bottom bearing cone (104) and cup (105). Remove socket (106) from ball (111). Remove nine nuts (107) and nine lockwashers (108) from ball side of axle housing and two capscrews (109) and lockwashers (110) from housing side. Removal ball (111). Remove bushing (112) from inside neck of ball and oil seal (113) from end of neck. Remove nine studs (114) from axle housing.

p. Remove four capscrews (115) from front and rear trunnion retaining plates and remove plates (116). Remove pins (117) and sleeve bearings (118) and remove trunnion (119) from ditcher.

q. Remove grease fitting (120) from trunnion pin. Remove magnetic plugs (121, 122, 123) from bottom of wheel hub, bottom of axle housing and cover plate. Remove the two relief fittings (124, 125) from socket and two grease fittings (126, 127) from ball neck. Remove relief fitting (128) from cover plate. Remove back nut (129), wheel nut (130) and wheel stud (131) from the hub.



MEC3805-240-35/6-6

Figure 6-6. Ring-gear removal.

6-3. Cleaning

a. Hardware and Metal Parts. Clean all hardware and metal parts in approved solvent; dry thoroughly.

b. Bearings. Clean bearings by immersing them in approved solvent and drying thoroughly with compressed air.

Caution: Do not spin rollers. Refer to TM 9-214 for instructions concerning proper handling of bearings.

c. Remove metallic particles from all magnetic plugs.

6-4. Inspection and Repair

a. Examine the cover plate and thrust-button assembly for a poorly fitting, scorched, scratched or discolored thrust button. Remove a damaged thrust-button with an arbor press. Inspect the thrust-button seat in the cover plate for scoring or distortion. Discard and replace a damaged cover plate. Discard and replace a damaged thrust button and install a new one with an arbor press.

b. Inspect the axle-shaft and cage-ring assembly for excess play, binding, loose tack welds, scored, bent or broken axle-shaft splines and bending, cracking or distortion of the axle shafts. Disassemble a defective axle shaft assembly in the numerical order shown in figure 6-1. Grind off the tack welds, remove the capscrews (69) and remove the two cage rings (70, 71). Inspect the capscrews for bent or broken threads and distortion or bending of the shanks. Inspect the cage rings for breaks and the journal surfaces for scratches, scoring and excessive wear. Replace all defective parts. Reassemble in reverse numerical order and torque the hardware to 50-60 ft-lbs. Tack-weld the shank ends of the screws to the face of the inside cage ring.

c. Inspect the tie-rod assembly (fig. 6-13) for a cracked, bent, broken or distorted tie rod, a cracked or broken ball stud and broken or bent threads on the ball-stud taper. Disassemble a defective tie-rod assembly in the numerical order shown in figure 6-13. Remove the nut (1), lockwasher (2), capscrew (3), and clamp (4). Remove the tie-rod (5). Inspect the tie-rod thread for breaks, bending and distortion. Discard and replace a damaged tie-rod. Inspect ball-stud threads for breaks, bending and distortion. Inspect dust cover for poor fit and deterioration. Remove and replace a deteriorated dust cover (6). Remove and inspect the grease fitting (7) for broken threads. Discard and replace a damaged grease fitting. Inspect the ball stud (8) for uneven or noisy movement, broken or damaged threads in the grease-fitting aperture and cracks on the surface. Discard and replace a damaged ball stud. Repack the ball stud with grease (LO 5-3805-240-12) and reassemble in reverse numerical order.

d. Inspect all hardware for breaks, cracks, stripped threads and other damage. Replace damaged or defective parts.

e. Inspect all metal bushings for scoring, cracks, breaks, discoloration, excessive wear and other damage. Discard and replace all defective bushings.

f. Inspect the nylon brake-camshaft bushings in the socket for warping, scoring, excess wear and discoloration. Do not remove bushings unless they are damaged or deteriorated. Discard and replace damaged bushings.

g. Discard and replace all seals.

h. Discard and replace all gaskets.

i. Inspect all shims for breaks and other damage. Discard and replace all damaged shims.

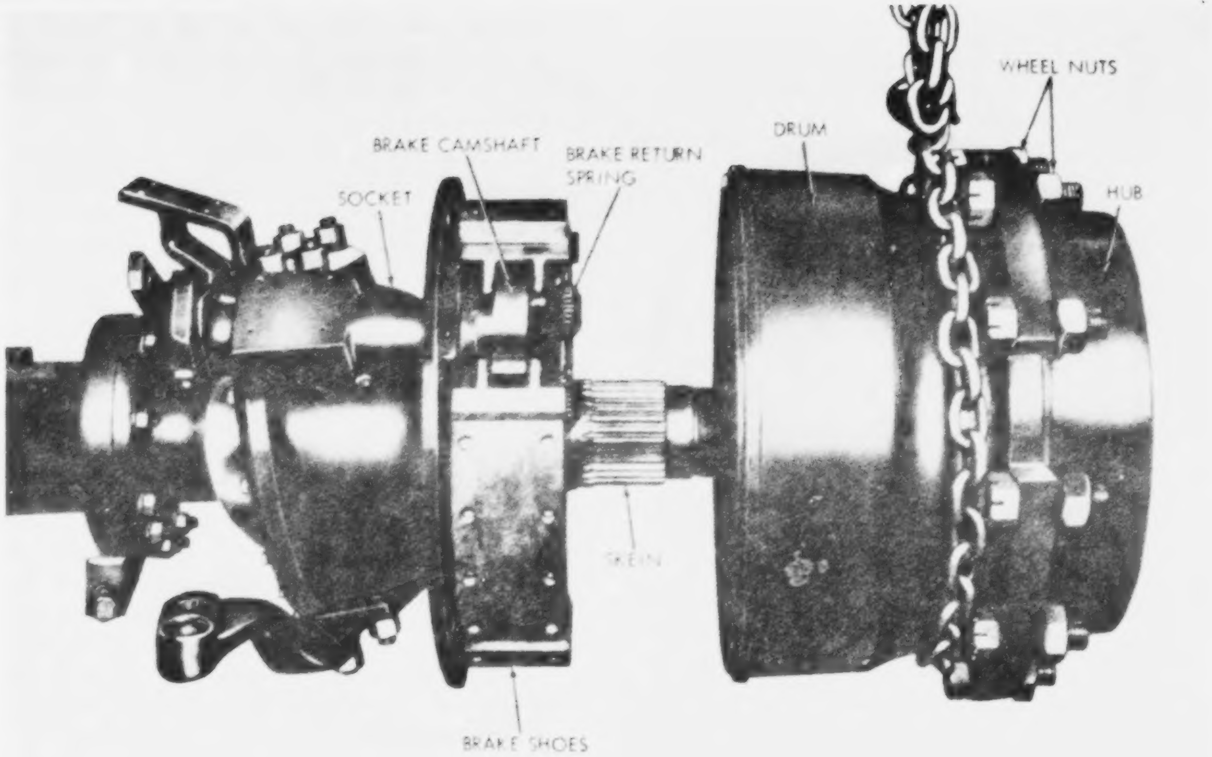


Figure 6-7. Hoisting and removing hub-and-drum assembly.

j. Inspect all springs and keys for weakness, loss of fit and distortion. Test the brake-shoe return spring by anchoring one end solidly and attaching a spring-scale to the other. Stretch the spring until it measures 8.875 in. in length. Note the reading on the scale. If the scale registers less than 62 lbs., discard the spring and replace it.

k. Inspect all pins and rollers for scoring, brinelling, pitting, flaking, discoloration and flat spots. Discard and replace damaged pins and rollers.

l. Inspect the sun gear and planetary gears for scoring, pitting, spalling, flaking, scratching, discoloration, excessive wear and broken teeth. Discard and replace damaged gears.

m. Inspect all castings for cracks, using dye-staining or other commercial processes, if equipment is available. Discard and replace all cracked castings. Inspect ring-gear teeth for breaks, cracks, pitting, spalling and scoring. Discard and replace a defective ring gear. Inspect socket ball for deep scratches in the region of the oil seal. Small scratches may be removed with a hone. Discard and replace a heavily or deeply scratched ball.

n. Inspect the brake shoes for cracks, breaks, distortion or other damage. When a defect is found, replace brake shoes as a pair.

o. Inspect the brake linings for wear, burns, breaks and oil-soaking. Replace defective or damaged linings.

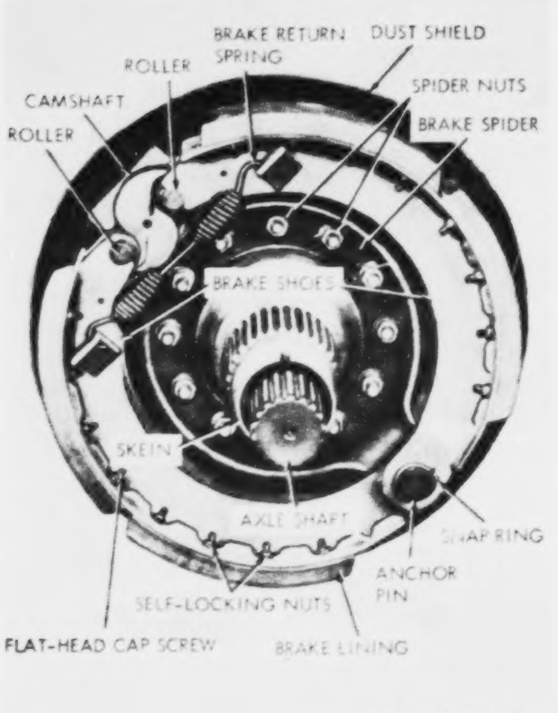
***Caution:* Always replace all linings on the same brake assembly at once. When one lining is found to be defective, four must be replaced. Replace linings when they are worn down to within 1/16 of an inch of the screw heads.**

6-5. Reassembly

Note. Before beginning reassembly, pack all bearings with grease and apply a coating of grease to the lips of all oil seals.

a. Place top and bottom bearing cups (102, 105, fig. 6-1) and cones (101, 104) in the steering ball (111). Install bushing (112) in ball neck.

Note. Be sure the grease hole in the ball-neck bushings is alined directly under the hole in the neck of the ball.



MEC 3805-240-35/6-8

Figure 6-8. Brake-shoe assembly.

b. Install the ball-neck oil seal (113) in the shoulder provided for it in the ball flange.

c. Apply a thin coat of plastic gasket compound to the face of the ball flange and the face of the axle-housing flange.

Note. Do not let plastic gasket compound touch oil seal or screw threads; confine the compound to mating surfaces only.

d. Insert studs (114) into axle-housing flange. Hang the ball-and-socket oil seal (84) on the neck of the ball for later installation and position ball on studs. Install lockwashers (108) and nuts (107) and torque hardware to 160–180 ft-lbs. Insert capscrews (109) through lockwashers (110) on inner face of axle-housing flange and torque to 280–310 ft-lbs (fig. 6–14).

e. If nylon bushings (58, 59) were removed from socket, install a new pair—one at each end of camshaft passage. Insert all four studs (91) in top of socket. Insert three short studs (98) and one long stud (99) in bottom of socket. Be sure long stud is installed where it will pass through the thickest part of the tie-rod arm. Install spider studs (65) in outer face of socket (fig. 6–15).

f. Position socket (106) over ball and insert bearing pins (100, 103) at top and bottom. Use a soft brass drift to drive pins into bearings. Install grease fittings (126, 127) on top of ball and ball neck.

g. Note original number and thickness of shims used on top (88, 89, 90) and bottom (95, 96, 97) of socket. Install same number of shims over studs. Apply an approved thread locking compound to the studs. Position the tie-rod arm (94) on the bottom socket studs and install lockwashers (93) and nuts (92). Torque hardware to 370–390 ft-lbs. Install steering arm (87) on left side and bearing cap on right side. Install lockwashers (86) and nuts (85) and torque hardware to 370–390 ft-lbs. Rap socket smartly from side to side to seat bearing pins and free socket swivel.

h. Attach a spring scale to the tie-rod arm (fig. 6–16) and test socket swivel by pulling on spring scale. The socket should begin to swivel when the tension on the scale is between 20 and 25 pounds. If more than 25 pounds is required to start the socket turning, add shims; if socket turns with less than 20 pounds of tension, remove shims and retest.

Note. Always add and remove shims in pairs—one from the top and one from the bottom. Be sure that both shims are of equal thickness.

Note. Test bearings before ball-and-socket seal is installed.

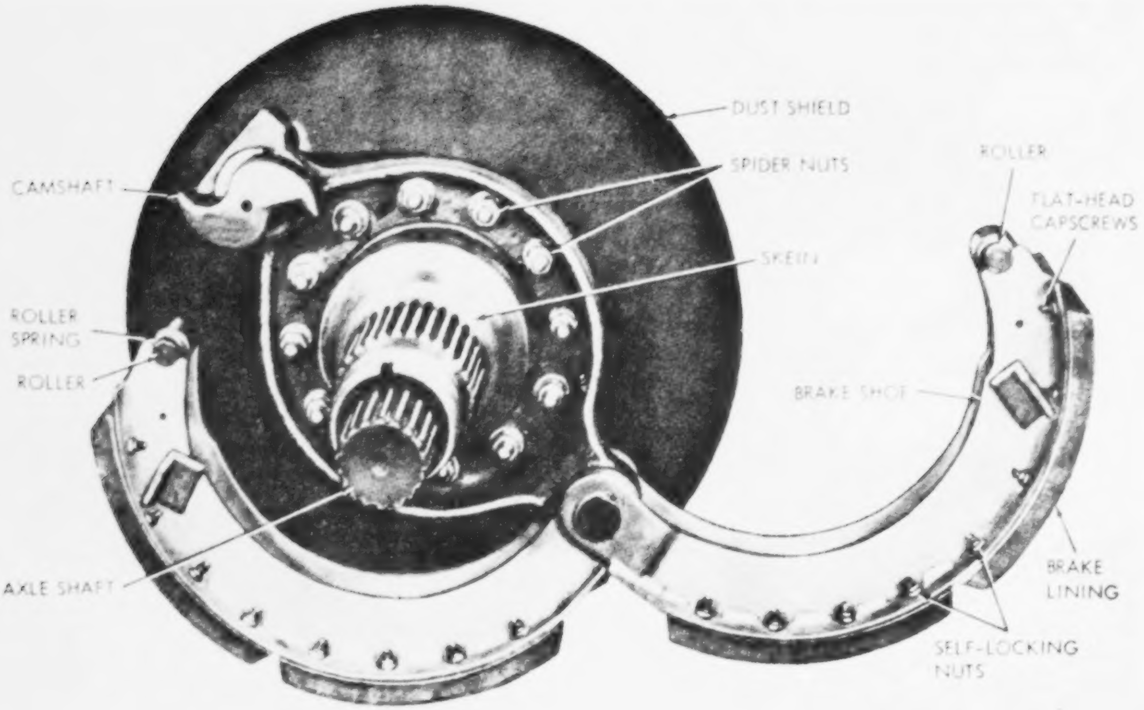
i. Clean the ball-and-socket oil seal (84) and coat the outer face (the side facing the socket) with sealant.

Note. Do not let the sealant touch the inside diameter of the seal; apply it only to that portion of the seal which will be in contact with the shoulder of the socket.

j. Force the seal into the socket shoulder with a soft tool. Stuff the rubber packing (83) into the channel in the seal. Install seal retainer strips (81, 82) and retainer connecting strips (79, 80), using lockwashers (78) and capscrews (77). Torque hardware to 17–20 ft-lbs (fig. 6–11).

k. Pack grease thickly around cage-ring assembly and around the inner axle-shaft shoulder which rides in the ball-neck bushing. Position the outer axle-shaft bearing (68), snap ring (67) and oil-seal (66) on the outer axle-shaft shoulder.

l. Insert axle-shaft assembly (69 through 73) into the axle housing and mesh the axle-shaft splines with the splines in the differential side



MEC3805-240-35/6-9

Figure 6-9. Brake-return spring removal.

gears. Position skein (64) on studs and tap skein into place with a soft drift.

m. Position the dust shield (63) and brake spider (62) on the studs and install lockwashers (61) and nuts (60). Torque hardware to 100–110 ft-lbs (fig. 6-17).

n. Install outer washer (57) and oil seal (56) on brake camshaft (53). Insert camshaft into spider and through socket. Install inner camshaft oil seal (55), spacer (54), slack adjuster (52), washer (51) and snap ring (50) (fig. 6-18).

o. Install new brake linings (49) on brake shoes (42, 41) by positioning lining on outside of shoe and inserting flat-head capscrews (48). Secure screws with self-locking nuts (47). Position rollers (46, 45) in their cradles and install roller clips (44, 43). Aline brake-shoe assemblies with hole at base of spider and drive the anchor pin (40) through shoes and spider. Install inner (38) and outer (39) snap rings. Attach brake-return spring (37) to welded blocks on brake shoes.

p. Install the two hub oil seals (36) on the skein shoulder, directly under the brake shoes. Install hub bearing cone (35) and cup (34) on the next shoulder outward. Bolt the drum (32) to the hub (33) with lockwashers (31) and capscrews (30). Torque hardware to 160–180 ft-lbs. Use a hoist of suitable capacity to lift the hub-and-drum assembly and position it on the bearing (fig. 6-11).

q. Install the bushing (27) in the ring gear (26). Install outer hub bearing cone (28) and cup (29) on the ring-gear neck. Position ring-gear assembly (26) on skein. Install skein lock nut (25), using the manufacturer's special wrench.

r. Insert one of the planetary spider capscrews (12) in a screw hole on the face of the hub. Attach one end of a spring scale to the screw (fig. 6-19). Pull the spring scale until the hub starts to revolve and note the reading on the scale. A force of 15–20 pounds should be sufficient to start the hub rolling. If more than 20 lbs. is required to start the hub, loosen the skein locknut and test again. If the hub rolls too easily, tighten the nut. When proper adjustment is reached, install the skein locknut clips (24).

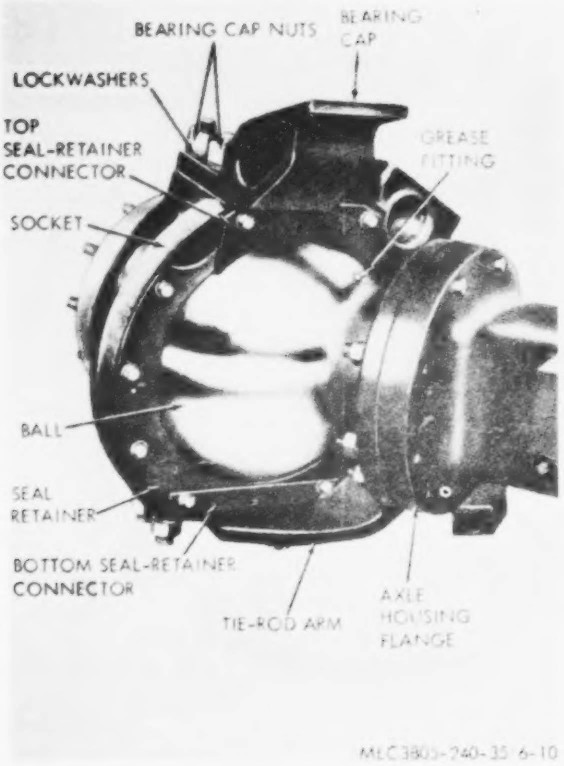

BEARING CAP NUTS
BEARING CAP
LOCKWASHERS
TOP SEAL-RETAINER CONNECTOR
SOCKET
GREASE FITTING
BALL
SEAL RETAINER
BOTTOM SEAL-RETAINER CONNECTOR
TIE-ROD ARM
AXLE HOUSING FLANGE
MEC3805-240-35/6-10

Figure 6–10. Ball-and -socket assembly.

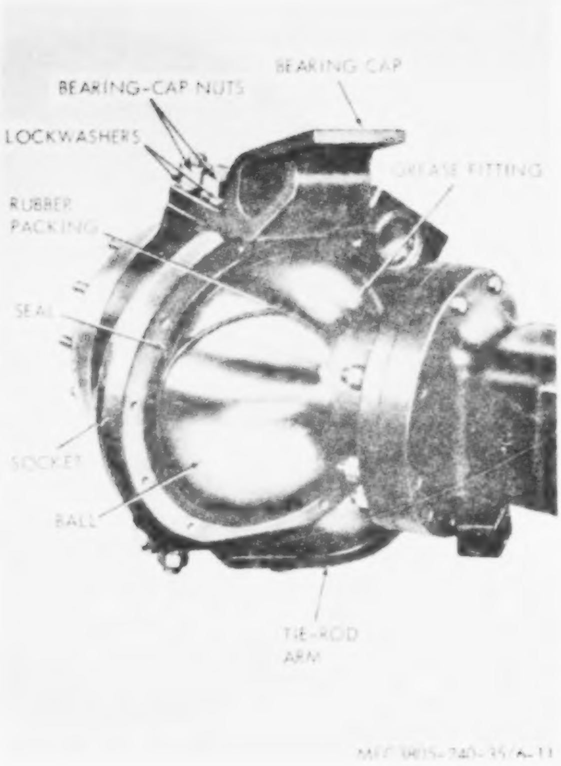

BEARING CAP
BEARING-CAP NUTS
LOCKWASHERS
GREASE FITTING
RUBBER PACKING
SEAL
SOCKET
BALL
TIE-ROD ARM
MEC 3805-240-35/6-11

Figure 6–11. Removal of seal-retainer connectors, seal retainers and rubber packing.

s. Lubricate all moving parts to be used in the planetary gear system. Lay planetary spider (15) face-up on work table. Position inner planet-gear thrust washer (19) against inner pin hole. Install planet-gear bearing spacer (23) and inner and outer bearings (21, 22) in each gear (18). Aline planet-gear assemblies on top of inner thrust washers and position outer thrust washers (20) over planet gears. Drive gear pins (16) through holes in spider and through gear centers. Insert ball (17) into each pin groove. Using hammer and punch, tap the spider flange lightly down around the ball, one punch on either side of ball.

t. Apply a thin coat of plastic gasket compound to the inner face of the spider flange and the outer face of the hub.

Note. Do not let plastic gasket compound touch screw threads or gears.

u. Aline holes in spider flange with holes in hub. Install lockwashers (13) and capscrews (12). Torque hardware to 100–110 ft-lbs. Insert and tighten puller-hole capscrews (14). Insert sun-gear thrust washer (11), sun gear (10) and snap ring (9).

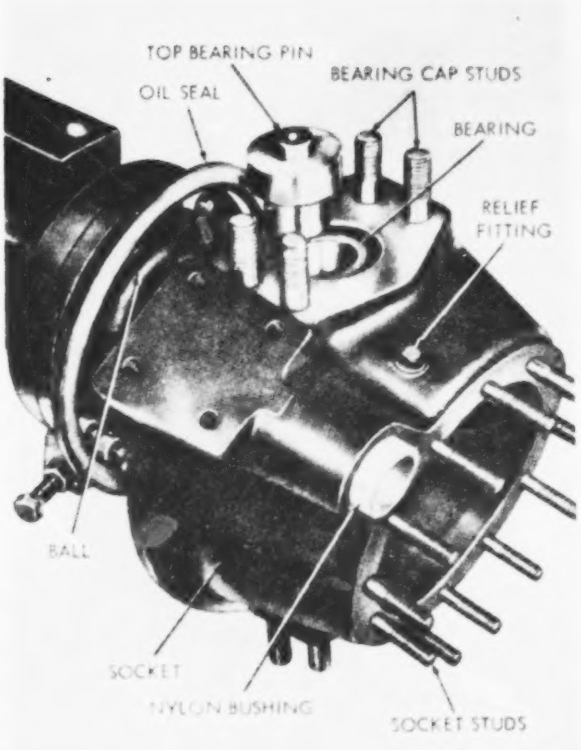
v. Position gasket (8) and cover-plate thrust-button assembly (6, 7) on spider and secure with lockwashers (5) and capscrews (4). Torque hardware to 50–58 ft-lbs.

w. Install tie-rod assembly (76) by driving ball-stud tapers sharply into holes in the tie-rod arms. Toque the tie-rod arm nut (75) to 110–125 ft-lbs. and install cotter pin (74). Install wheel studs (131) in hub. Install back nuts (129) on wheel studs and torque nuts to 175–200 ft-lbs. Install wheel nuts (130) but do not torque.

x. Grease the trunnion sleeve bearing (118) and the grooved pin (117) (LO 5-3805-240-12) and install them in the trunnion (119) and the trunnion-support weldment. Install the pin grease fitting (120), the retaining plate (116) and the capscrews (115)

y. Installation. Refer to TM 5-3805-240-12) and install the wheels on the planetary ends. Refer to paragraph 2-46 and install the axle assembly on the ditcher.

Note. Before lubricating the front axle assembly, be sure that the wheels have been rotated so that the oil filler and level hole on the cover plate is at the bottom

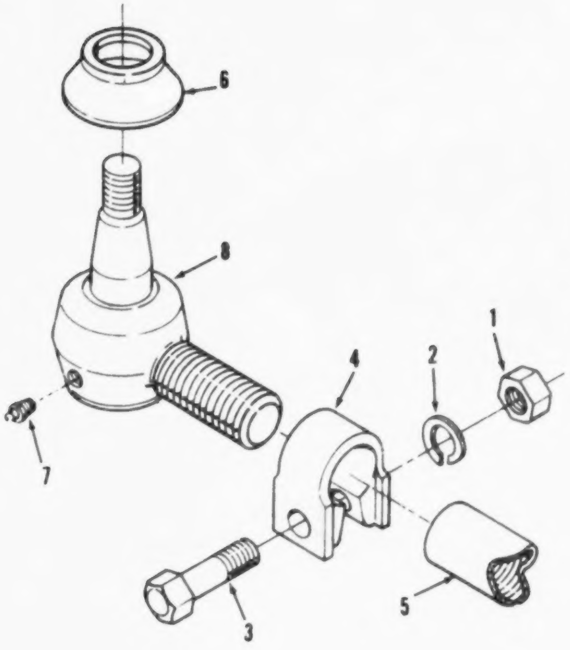


MEC3805-240-35/6-12

Figure 6–12. Removal of bearing cap, tie-rod arm and top and bottom shims.

of the plate. The hole for the relief fitting should be directly above the filler hole.

z. Install the magnetic drain plugs (121, 122) in the hub and axle housing. Add lubricating oil (LO 5-3805-240-12) through the level and filler hole in the cover plate (if differential has not been lubricated, add oil through the filler hole located in the differential carrier. Refer to figure 6-21 for location of differential filler hole). Install magnetic level and filler plug (123) and relief fitting (128) in the cover plate. Install relief fittings (124, 125) on socket. Add grease (LO 5-3805-240-12) to ball and ball neck and install the grease fittings (126, 127). Install the steering stop nut (133) and capscrew (132). Adjust the stop screw so that it allows the tie-rod arm to swing no more than 28° inward and 23° outward.



MEC3805-240-35/6-13

1	Nut, 5/8–18
2	Lockwasher, 5/8 in.
3	Capscrew, 5/8–18 x 2.75 in.
4	Clamp
5	Tie rod
6	Dust cover
7	Grease fitting
8	Ball stud

Figure 6–13. Tie-rod assembly, exploded view.

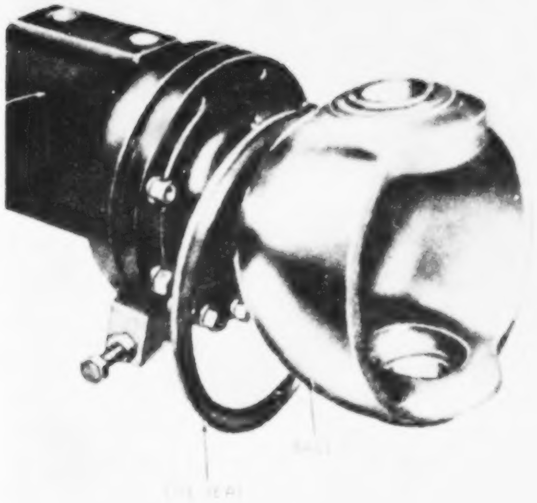
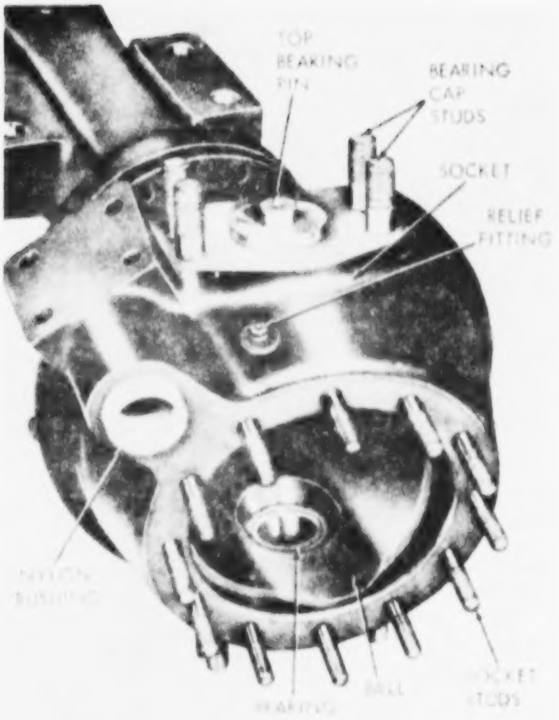

OIL SEAL
BALL

Figure 6-14. Ball assembled on axle housing, with seal hanging from ball.


TOP BEARING PIN
BEARING CAP STUDS
SOCKET
RELIEF FITTING
NYLON BUSHING
BEARING
BALL
SOCKET STUDS

MEC 3805-240-35/6-15

Figure 6-15. Ball-and-socket assembly, with top bearing pin, bearing-cap studs and spider studs in place.

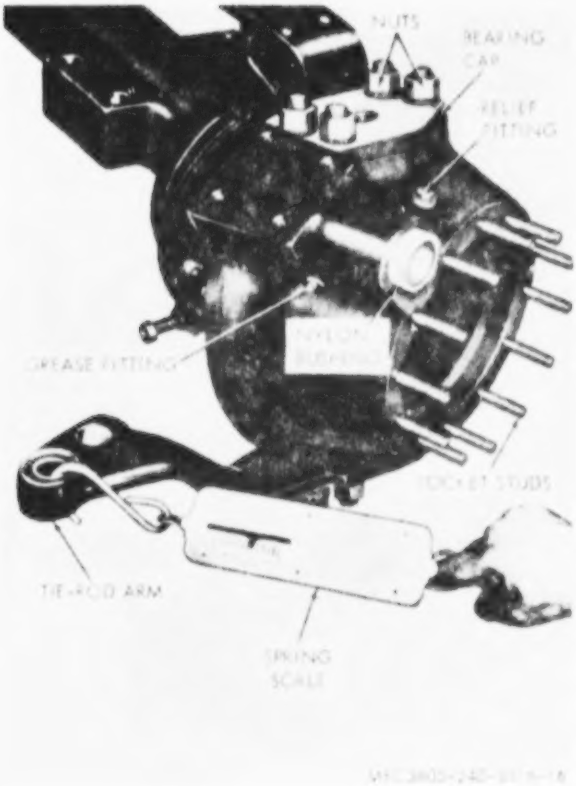
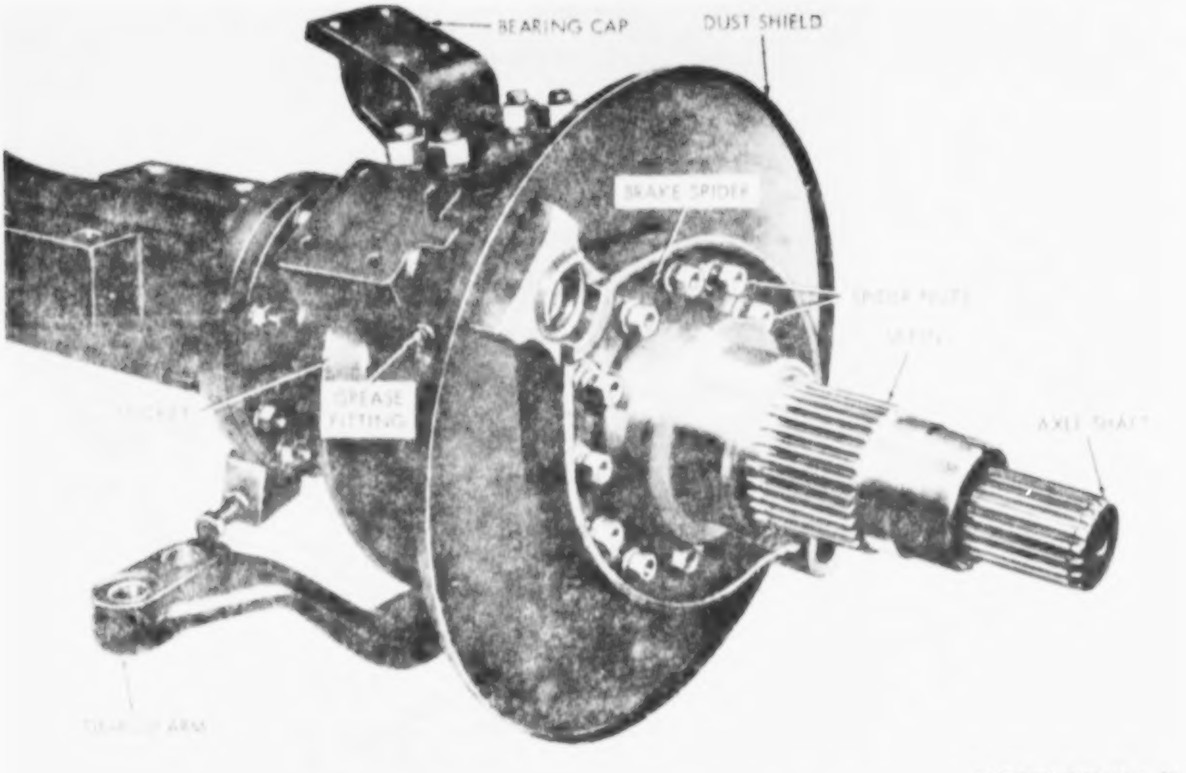

NUTS
BEARING CAP
RELIEF FITTING
NYLON BUSHING
GREASE FITTING
SOCKET STUDS
TIE-ROD ARM
SPRING SCALE

Figure 6-16. Testing ball-and-socket swivel with spring scale.


BEARING CAP
DUST SHIELD
BRAKE SPIDER
SPIDER BOLTS
SKEIN
AXLE SHAFT
SOCKET
GREASE FITTING
STEERING ARM

MEC 3805-240-35/6-17

Figure 6-17. Ball-and-socket assembly, with dust shield, spider and skein in place.

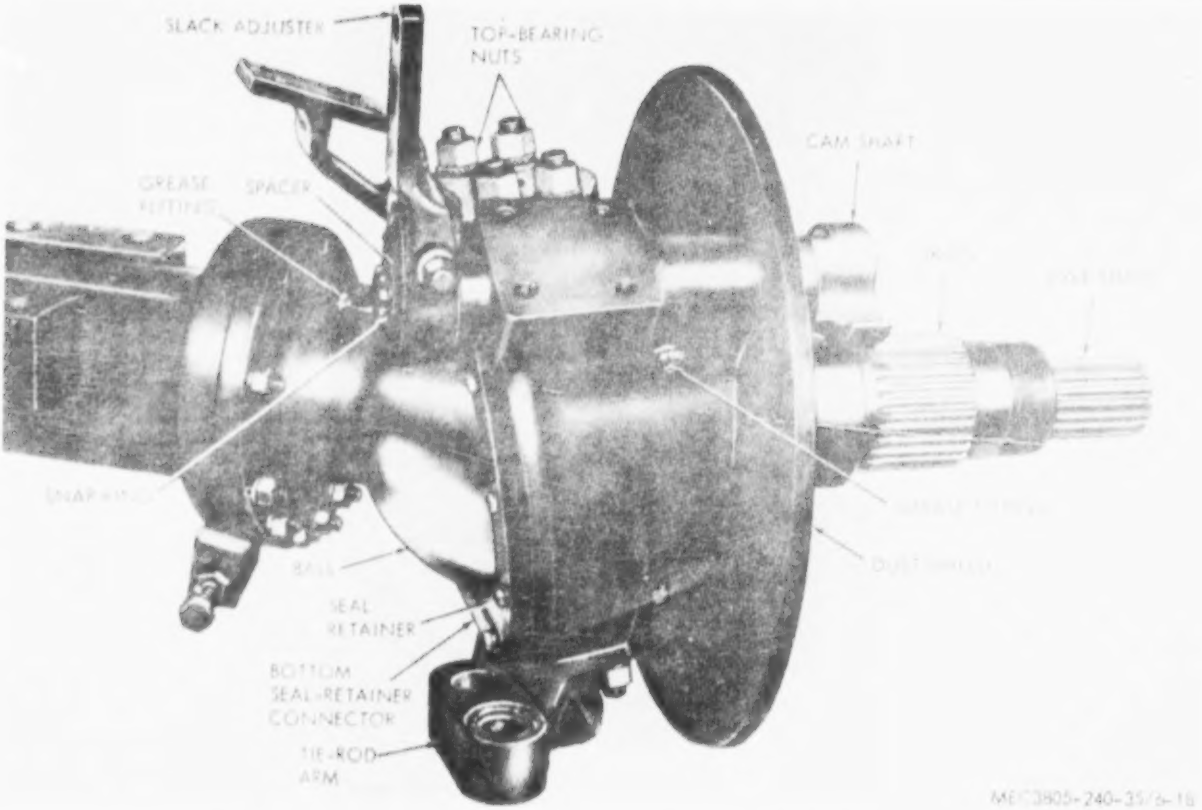
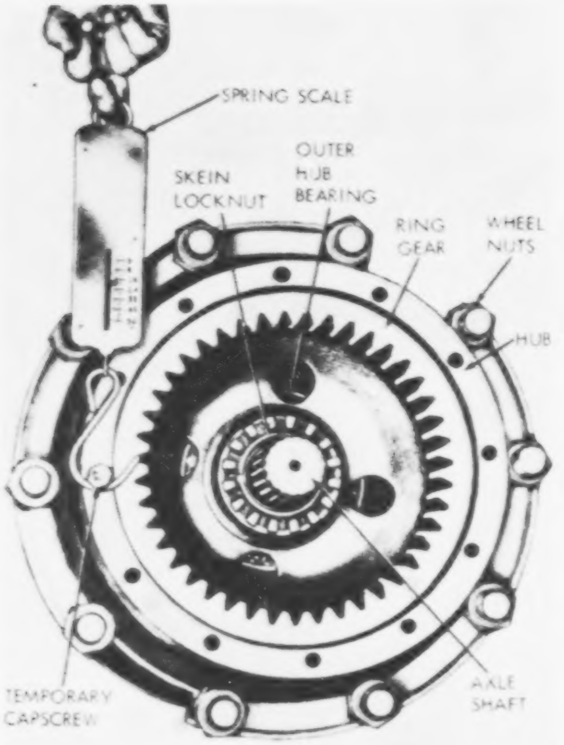

SLACK ADJUSTER
TOP-BEARING NUTS
CAM SHAFT
GREASE FITTING
SPACER
AXLE SHAFT
SNAP RING
GREASE FITTING
DUST SHIELD
BALL
SEAL RETAINER
BOTTOM SEAL-RETAINER CONNECTOR
TIE-ROD ARM
MEC3805-240-35/6-18

Figure 6-18. Ball-and-socket assembly, with brake camshaft assembly and slack adjuster in place.



MEC3805-240-35 6-19

Figure 6-19. Testing hub bearing for proper adjustment.

Section III. REAR PLANETARIES

Note. The two ends of the rear planetary system are not identical: some of the parts used on the right side will not fit on the left. When disassembling the front axle assembly, keep parts from each side separate.

6-6. Disassembly

a. Refer to paragraph 2-47 and remove the rear axle assembly from the ditcher. Move the axle assembly to a suitable work area. Refer to TM 5-3805-240-12 and remove the wheels. Replace the back nuts and wheel nuts before disassembling the axle in the numerical order shown in figure 6-20.

Note. Before disassembling the planetary system, drain the entire rear axle assembly by removing the drain plugs at the bottom of the wheel hub and the bottom of the axle housing under the differential. When all fluid has drained off, screw the drain plugs back into the proper holes.

b. Remove the planetary outer assemblies. Refer to *b* through *h*, paragraph 6-2.

c. Remove the brake-camshaft snap ring (50) and slack adjuster (51). Remove the washer (52) from the inner end of the camshaft (53) and remove the camshaft from the spider. Remove spacer (58), inner and outer seal retainers (54, 57), and inner and outer felt seals (55, 56).

Note. The nylon camshaft bushings (59, 60) may be removed at this time. Refer to *f*, paragraph 6-4.

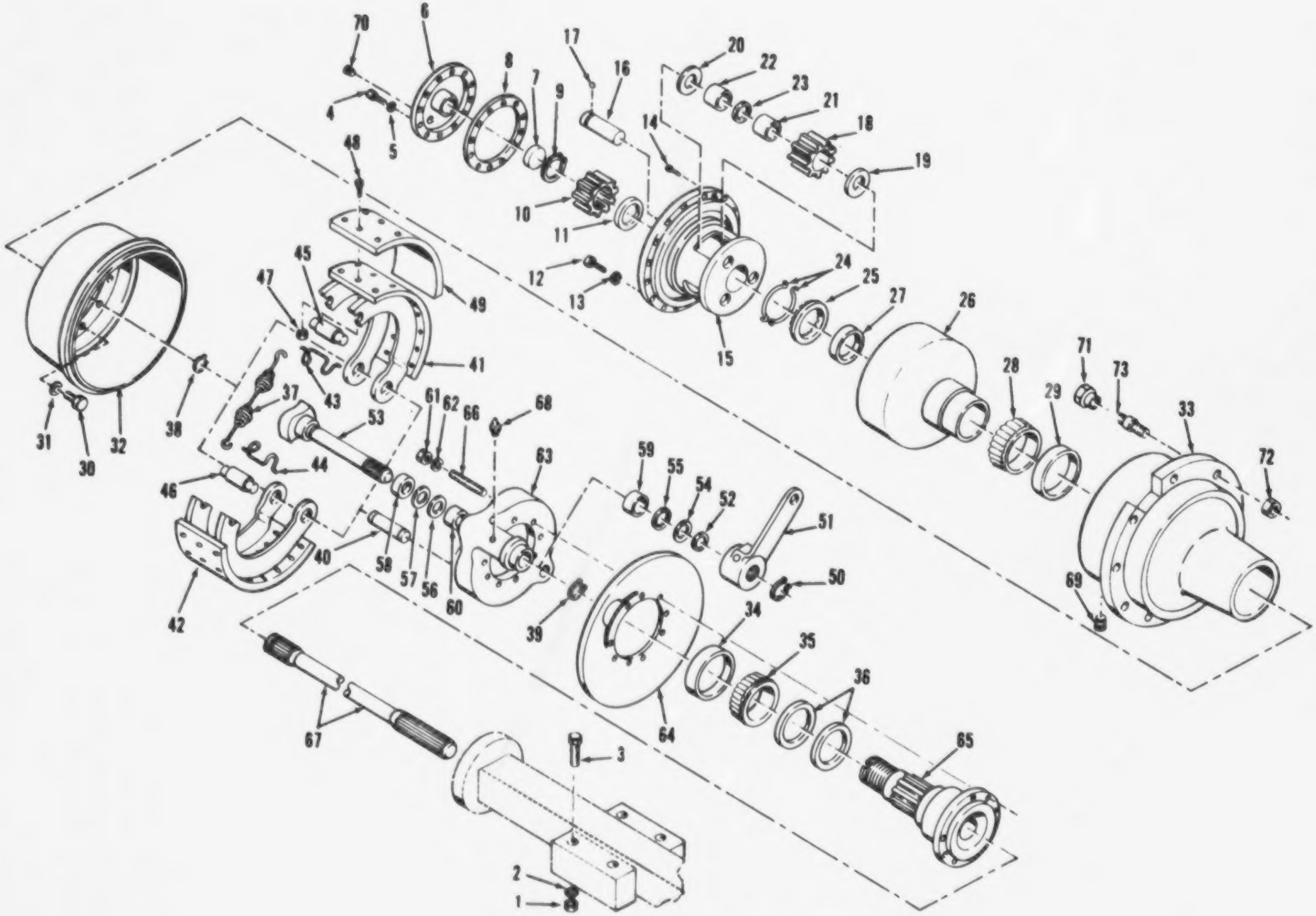
d. Remove nine nuts (61) and lockwashers (62) from the brake spider (63) and remove the spider and dust shield (64). Remove skein (65). Refer to *d*, paragraph 6-4, and examine skein studs (66). Remove any studs which appear to be damaged.

e. Remove axle shaft (67).

f. Remove grease fitting (68) from top of camshaft passage in spider. Remove drain plug (69) from bottom of hub and level plug (70) form cover plate. Remove wheel nut (71) and back nut (72) from hub. Remove wheel stud (73).

6-7. Cleaning

a. Clean all hardware and metal parts in an approved solvent.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1 Nut, 1-8 (8 rqr)
2 Lockwasher, 1 in. (8 rqr)
3 Machine bolt, 1-8 x 5 1/2 in. (8 rqr)
4 Capscrew, 7/16-20 x 1 1/4 in. (6 rqr)
5 Lockwasher, 7/16 in. (6 rqr)
6 Cover plate

Figure 6-20. Rear axle and brake assembly, exploded view.

7	Thrust button
8	Gasket
9	Sun-gear snap ring
10	Sun gear
11	Sun-gear thrust washer
12	Capscrew, 1/2-20 x 2 in. (12 rqr)
13	Lockwasher, 1/2 in. (12 rqr)
14	Puller-hole capscrew, 1/2-20 x 1/2 in. (2 rqr)
15	Planetary spider
16	Planetary gear pin (3 rqr)
17	Ball (3 rqr)
18	Planet gear (3 rqr)
19	Inner planet-gear thrust washer (3 rqr)
20	Outer planet-gear thrust washer (3 rqr)
21	Inner planet-gear roller bearing (3 rqr)
22	Outer planet-gear roller bearing (3 rqr)
23	Planet-gear bearing spacer (3 rqr)
24	Skein locknut key (2 rqr)
25	Skein locknut
26	Ring gear
27	Ring-gear bushing
28	Tapered roller bearing cone
29	Tapered roller bearing cup
30	Capscrew, 5/8-18 x 1.88 (8 rqr)
31	Lockwasher, 5/8 in. (8 rqr)
32	Brake drum
33	Wheel hub
34	Tapered roller bearing cup
35	Tapered roller bearing cone
36	Oil seal (2 rqr)
37	Brake-shoe return spring
38	Outer anchor-pin snap ring
39	Inner anchor-pin snap ring
40	Anchor pin
41	Trailing brake shoe
42	Leading brake shoe
43	Trailing brake-shoe roller spring
44	Leading brake-shoe roller spring
45	Trailing brake-shoe roller
46	Leading brake-shoe roller
47	Self-locking nut, 1/2-28 (48 rqr)
48	Flat-head slotted capscrew, 1/4-28 x 1 in. (48 rqr)
49	Brake lining (4 rqr)
50	Brake camshaft snap ring
51	Brake slack adjuster
52	Washer
53	Brake camshaft
54	Inner seal retainer
55	Inner felt seal
56	Outer felt seal
57	Outer seal retainer
58	Spacer
59	Inner nylon bushing
60	Outer nylon bushing
61	Brake spider nut, 5/8-18 (9 rqr)
62	Lockwasher, 5/8 in. (9 rqr)
63	Brake spider
64	Dust shield
65	Skein
66	Stud, 5/8-18 x 3 in. (9 rqr)
67	Axle shaft
68	Grease fitting, 1/8 in. NPT
69	Magnetic drain plug, 3/4 in. NPT
70	Magnetic level plug, 3/4 in. NPT
71	Wheel nut, 1 1/8-16 (10 rqr)
72	Back nut, 1-14 (10 rqr)
73	Wheel stud (10 rqr)

Figure 6-20—Continued

b. Clean all bearings by immersing them in an approved solvent and drying thoroughly with an air gun.

Caution: **Do not spin bearing rollers. Refer to TM 9-214 for instructions concerning proper handling of bearings.**

c. Remove all metal particles from magnetic plugs.

6-8. Inspection and Repair

a. Refer to *a*, paragraph 6-4.

b. Refer to *d*, paragraph 6-4.

c. Inspect the ring-gear bushing for scoring, cracks, breaks, discoloration, excessive wear and other damage. Discard and replace a defective bushing.

d. Refer to *f* through *h*, paragraph 6-4.

e. Refer to *j* through *l*, paragraph 6-4.

f. Inspect all castings for cracks, using dye-staining or other commercial processes if equipment is available. Discard and replace all cracked castings. Inspect ring-gear teeth for breaks, cracks, pitting, spalling and scoring. Discard and replace a defective ring gear.

g. Refer to *n* and *o*, paragraph 6-4.

6-9. Reassembly

Note. Before beginning reassembly, repack all bearings with grease and apply a coating of grease to the lips of all oil seals.

a. Install the axle shaft (67) by meshing the axle-shaft splines with the splines in the differential side gears.

b. Install the skein studs (66) in the axle-housing flange. Position the skein (65), dust shield (64) and brake spider (63) on studs and install lockwashers (62) and nuts (11). Torque hardware to 160-180 ft-lbs.

c. If nylon bushings (59, 60) were removed from spider, install new ones at each end of camshaft passage. Install felt oil seals (55, 56) at inner and outer end of camshaft passage in spider. Install a spacer (58) and retainer (57) on the outer end of the camshaft and push the camshaft (53) into the spider from the outer end. Install a retainer (54), washer (52), slack adjuster (51) and install lockwashers (62) and nuts (61). shaft.

d. Refer to *o* through *v*, paragraph 6-5.

e. Apply grease through the camshaft grease hole (LO 5-3805-240-12) and install the grease fitting (68). Install the magnetic drain plugs in the hub and bottom of axle housing. Fill the outer planetary ends with lubricating oil through the level and filler hole in the cover plate.

Note. To obtain the proper oil level, be sure the wheel has been rotated until the level and filler hole is at the bottom of the cover plate. When proper amount of oil has been added through the cover plate the differential is also lubricated.

f. Install wheel studs (73) and back nuts (72) and torque back nuts to 175-200 ft-lbs. Install wheel nuts (71) but do not torque.

g. Installation. Refer to TM 5-3805-240-12 and install wheels on axle. Refer to paragraph 2-47 and install the axle assembly on the ditcher.

Section IV. FRONT DIFFERENTIAL ASSEMBLY

6-10. Disassembly

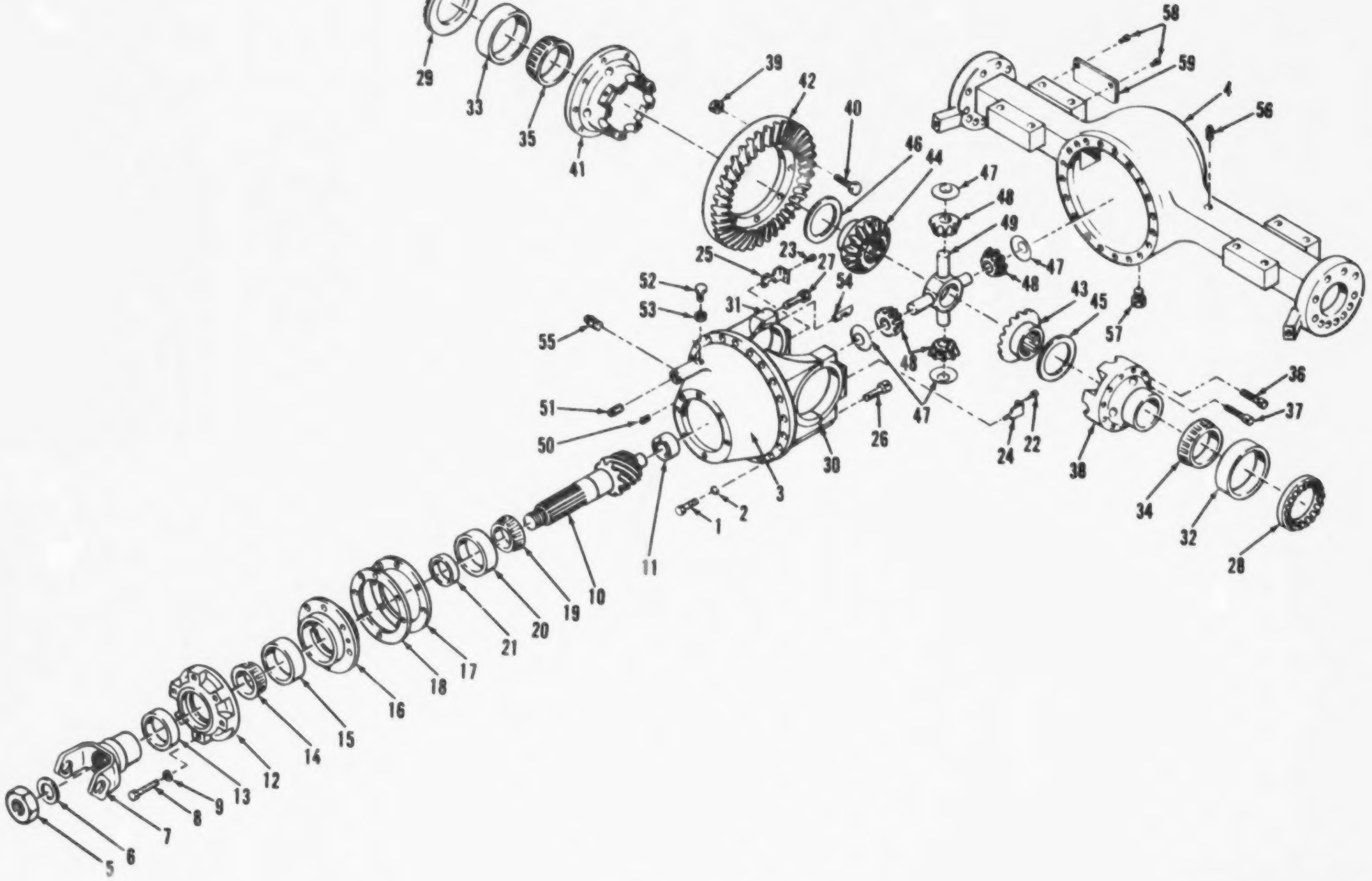
a. Removal. Refer to paragraph 2-44 and remove the differential assembly from the axle housing, then proceed with disassembly in the numerical order shown in figure 6-21.

Note. The following paragraphs apply to the disassembly of the front differential after the planetaries, brakes and axle shafts have been removed. Before starting disassembly, loosen the yoke nut (5) while the ditcher is still resting on the ground, but do not remove the nut. If wheels have already been removed from the ditcher, secure the yoke so that the nut can be turned. During this step the 20 capscrews (1) and lockwashers (2) securing the carrier (3) in the axle housing (4) are removed. After carrier has been removed from axle housing, move it to a suitable work table for further disassembly (figs. 6-22, 6-23).

b. Remove yoke nut (5, fig. 6-21) lockwasher (6) and yoke (7). Remove six capscrews (8) and lockwashers (9) and grasp pinion (10) by splined end. Pull entire pinion assembly from carrier and remove pinion pilot bearing (11) from its shoulder in the carrier.

c. Remove oil-seal retainer (12) and oil seal (13). Remove outer pinion-bearing cone (14) and cup (15). Remove bearing retainer (16) and shims (17, 18) and note number and sizes of shims used. Remove inner bearing cone (19), cup (20) and pinion bearing spacer (21).

d. Cut through safety wire and remove the small capscrews (22, 23) securing the bearing-cap adjusting locks (24, 25). Remove adjusting locks. Cut the safety wires securing the bearing-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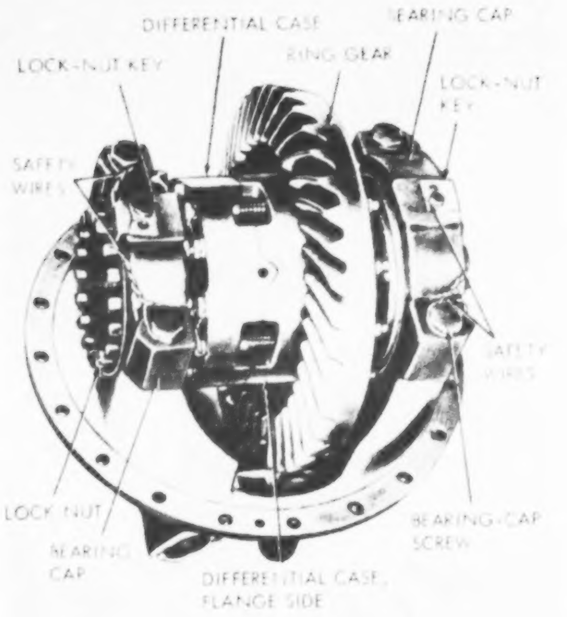
1 Capscrew, 1/2-20 x 1 1/4 in. (20 rqr)
2 Lockwasher, 1/2 in. (20 rqr)
3 Differential carrier
4 Axle housing
5 Elastic stop nut, 1 1/4-12
6 Washer, 1 1/4 in.

Figure 6-21. Front differential assembly, exploded view.

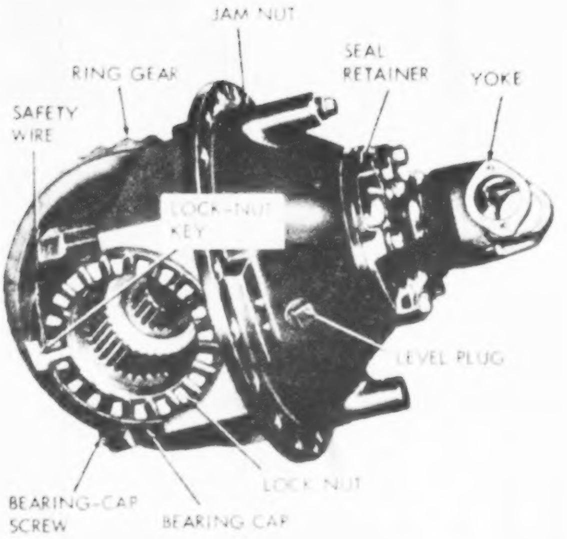
7 Yoke
8 Capscrew, 5/8–11 x 2 1/2 in. (6 rqr)
9 Lockwasher, 5/8 in. (6 rqr)
10 Pinion
11 Pinion pilot bearing
12 Oil-seal retainer
13 Oil seal
14 Outer pinion-bearing cone
15 Outer pinion-bearing cup
16 Bearing retainer
17 Shim, .005 in. (as rqr)
18 Shim, .010 in.
19 Inner pinion-bearing cone
20 Inner pinion-bearing cup
21 Bearing spacer
22 Socket-head capscrew, 3/8–16 x .62 in.
23 Socket-head capscrew, 3/8–16 x .62 in.
24 Adjusting lock
25 Adjusting lock
26 Socket-head bearing-cap screw, 3/4–10 x 4 in. (2 rqr)
27 Socket-head bearing-cap screw, 3/4–10 x 4 in. (2 rqr)
28 Side-bearing locknut
29 Side-bearing locknut
30 Bearing cap
31 Bearing cap
32 Side-bearing cup
33 Side-bearing cup
34 Side-bearing cone
35 Side-bearing cone
36 Socket-head capscrew, 1/2–13 x 2 3/4 in. (8 rqr)
37 Socket-head capscrew, 1/2–13 x 3 1/2 in. (4 rqr)
38 Differential case, plain half
39 Nut, 1/2–20 (12 rqr)
40 Capscrew, 1/2-20 x 2 in. (12 rqr)
41 Differential case, flange half
42 Ring gear
43 Side gear
44 Side gear
45 Side-gear thrust washer
46 Side-gear thrust washer
47 Spider-gear thrust washer (4 rqr)
48 Spider gear (4 rqr)
49 Spider
50 Pipe plug, 1/8 in. NPT (2 rqr)
51 Oil-scoop pipe plug, 3/4 in. NPT
52 Set screw, 1/4–20 x 5/8 in.
53 Jam nut, 1/4–20
54 Oil scoop
55 Level plug
56 Relief fitting, 1/8 in. NPT
57 Magnetic drain plug, 3/4 in. NPT
58 Drive screw (2 rqr)
59 Name plate

Figure 6–21—Continued


DIFFERENTIAL CASE
BEARING CAP
RING GEAR
LOCK-NUT KEY
LOCK-NUT KEY
SAFETY WIRES
SAFETY WIRES
LOCK NUT
BEARING CAP
BEARING-CAP SCREW
DIFFERENTIAL CASE, FLANGE SIDE

MEC3805-240-35/6-22

Figure 6-22. Differential carrier assembly, rear view.


JAM NUT
SEAL RETAINER
RING GEAR
YOKE
SAFETY WIRE
LOCK-NUT KEY
LEVEL PLUG
LOCK NUT
BEARING-CAP SCREW
BEARING CAP

MEC3805-240-35/6-23

Figure 6-23. Differential carrier assembly, side view.

cap screws (26, 27) and loosen the screws a sufficient amount to allow the side-bearing lock nuts to be removed. Remove the lock nuts (28, 29), then remove screws completely and remove the bearing caps (30, 31) from the carrier. Remove the differential case assembly from the carrier.

e. Remove the side-bearing cups (32, 33) and cones (34, 35). Cut the safety wires securing the differential-case capscrews (36, 37). Remove the eight short capscrews (36) and the four long capscrews (37) and remove the plain half of the differential case (38).

f. Remove 12 nuts (39) and capscrews (40) from the ring gear (42) and flange half of the differential case (41) and separate the gear and case. Remove the side gears (43, 44) from both halves of the differential case and remove the thrust washers (45, 46) from the side gears.

g. Remove spider-gear thrust washers (47) and spider gears (48) from the differential spider (49). Remove the two pipe plugs (50) from the side of the carrier. Remove oil-scoop pipe plug (51) from front of carrier. Remove set screw and jam nut (53) from top of oil-scoop pipe and remove oil scoop (54) from back of pipe. Remove the level plug (55) from the side of the carrier, relief fitting (56) from top of axle housing and magnetic drain plug (57) from bottom. Do not remove drive screws (58) or name plate (59) unless necessary.

6-11. Cleaning

a. Clean all metal parts in approved solvent and dry thoroughly.

b. Clean all bearings by immersing them in an approved solvent and drying with an air gun.

Note. Do not spin rollers. Refer to TM 9-214 for instructions concerning proper handling of bearings.

c. Remove metallic particles from magnetic drain plug.

6-12. Inspection and Repair

a. Inspect all hardware for cracks, breaks, distortion, stripped threads and other damage. Discard and replace damaged hardware.

b. Discard and replace the pinion oil seal.

c. Inspect adjusting locks for loss of strength, loss of alignment and cracks. Replace defective locks.

d. Inspect all shims for cracks and breaks, and replace defective shims.

e. Inspect all bearings for noisy, uneven rolling, spalling, pitting, brinelling or corrosion of the races or rollers and loss of alinement between cups and cones. Discard and replace all damaged bearings.

f. Inspect all castings and forgings for cracks, using dye-staining and other commercial processes if equipment is available. Replace all cracked castings and forgings. Inspect all threads in castings and replace castings with damaged threads.

g. Inspect all shafts for bending, distortion and loss of alinement. Discard and replace all bent shafts.

h. Inspect all gears and splines for cracks and breaks and for spalling, pitting, flaking, scoring and discoloration of the teeth. Replace all defective gears and all shafts with damaged splines.

i. Inspect the oil scoop for proper fit and alignment. Discard and replace a damaged oil scoop.

Note. Certain parts used in the differential assembly are manufactured in matched sets and may not be replaced singly. These include the ring gear and pinion, which must be replaced at the same time with a new matched set, and the differential carrier and bearing caps, which are machined as one assembly with matching threads for the side-bearing locknuts. If any single component is found to be damaged or defective, replace the entire assembly.

6-13. Reassembly

a. Lubricate the spider (49) and the four spider gears (48) (LO 5-3805-240-12) and assemble the gears on the spider. Install the spider-gear thrust washer (47) on the spider gears (fig. 6-24).

b. Install the side-gear thrust washers (45, 46) on the side gears (43, 44) (fig. 6-24) and place the side gears in both halves of the differential case (38, 41). Install ring gear (42) on flange half of differential case (41) with capscrews (40) and nuts (39). Torque hardware to 100-110 ft-lbs.

c. Place spider assembly against side gear in flange half of differential case. Bolt the two halves of the case together with four long (37) and eight short socket-head capscrews (36). Torque hardware to 70-80 ft-lbs. and wire the screw heads together in pairs with 14-gage safety wire.

d. Insert the oil scoop (54) into the oil-scoop pipe from the inside of the differential carrier. Place the assembled differential case with gears in the carrier and install the bearing caps (30, 31) and bearing-cap socket head screws (26, 27). Torque the screws finger-tight and install the side-bearing lock nuts (28, 29). Tighten the lock nuts until the differential case fits snugly and ring-gear end play is eliminated. Torque the bearing cap socket-head screws to 330-350 ft-lbs.

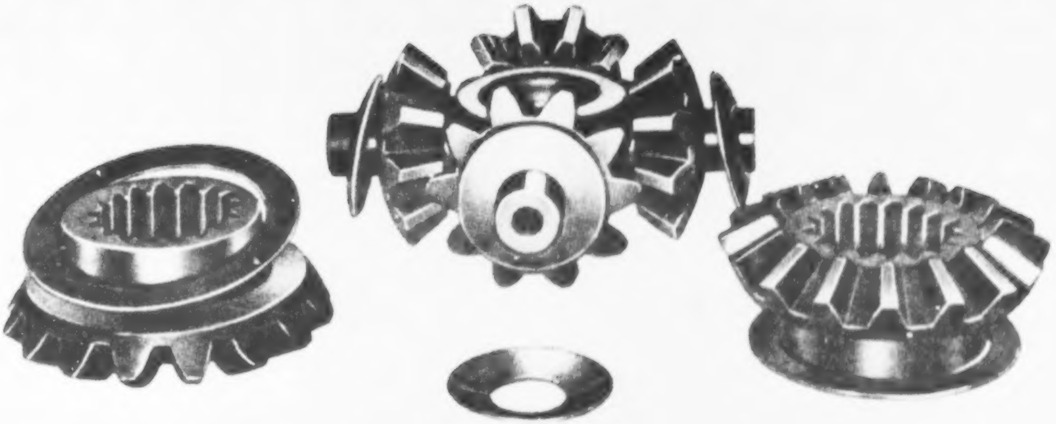
e. Attach a dial indicator firmly to the carrier and place the plunger in contact with a smooth surface on the back of the ring gear (fig. 6-25). Rotate the ring gear and note any variations on the dial. Maximum permissible runout is .005 in. Run out in excess of this figure indicates the carrier has become distorted. Replace a defective or damaged carrier.

f. Assemble the inner pinion-bearing cone (19) and cup (20) in the bearing retainer (16). Select one of the thicker bearing spaders (21) from the spacer kit and install it in the middle of the bearing retainer. Install the outer pinion-bearing cup (15) and cone (14) in the retainer and install the bearing assembly on the pinion (10). Install the yoke (7) on the splined end of the pinion. Attach the washer (6) and yoke nut (5) and place the assembly in a soft-jawed vise, with the vise gripping the yoke firmly. Torque the yoke nut to 750 ft-lbs.

Note. Do not install the pinion oil seal or the oil-seal retainer as part of this step. These parts are to be installed only after the tests for pinion-bearing preload have been completed. These tests are described below and must be followed precisely in order to achieve correct bearing preload and performance.

g. With the pinion assembly (minus oil seal and retainer) firmly torqued up, place the assembly in a soft-jawed vise, with the jaws of the vise gripping the yoke and the geared end of the pinion sticking straight up. Attach a dial indicator to the yoke with the plunger contacting the underside of the bearing-retainer flange. Set the dial indicator at zero. Grasp the bearing-retainer flange firmly and pull upward until the top bearing becomes seated (fig. 6-26). Note reading on dial. This figure, plus .002 in., represents the difference between the thickness of the existing spacer and the one which should be used. Disassemble the pinion assembly and select the appropriate spacer. If the exact size is not available, select a spacer of the next larger size and grind it down by rubbing it on a sheet of emery paper on a flat surface. Install the new spacer, reassemble the pinion and test again. It may be necessary to repeat this test several times.

h. When the correct pinion-bearing spacing has been obtained, remove the pinion assembly from the vise and turn it sideways so that the vise jaws grip the flange of the bearing retainer



MEC 3805-240-35/6-24

Figure 6-24. Spider gear assembly (center) and side-gear assemblies (left and right).

and the yoke is free to turn. Wind a stout cord around the neck of the yoke. Attach the free end of the cord to a spring scale. Start the yoke rotating by hand, then continue to rotate it by pulling on the cord. While the yoke is rotating, note the reading on the scale. Correct turning torque is 15–20 in-lbs. If more than 20 in-lbs of force is required to turn the yoke, a smaller spacer must be used. If the pinion rotates with less than 15 in-lbs. of torque applied, a thicker spacer is needed. Make the necessary corrections.

i. Remove the yoke nut, washer and yoke. Install the pinion oil seal (13) in the oil-seal retainer (12). Install the retainer on the pinion and replace the yoke. Torque the nut to 750 ft-lbs. (Hold yoke in soft-jawed vise to turn nut). Insert the pinion pilot bearing (11) in its shoulder in the carrier. Select appropriate shims (17, 18) to build up an initial shim cluster measuring .060 in. in thickness. Install shims on inner face of bearing-retainer flange. Mesh the pinion with the ring gear, install lockwashers (9) and capscrews (8) and torque the hardware to 140–160 ft-lbs.

Caution: **Before final installation of shims and pinion assembly, be sure the extra lubrication hole in the shims and bearing-retainer flange (fig. 6-27) is alined with the corresponding hole in the face of the carrier casting.**

j. Attach a dial indicator to the carrier so that the plunger contacts the side of one ring-gear tooth. Rotate the ring gear while holding the pinion steady. Note the backlash as indicated on the dial. The backlash for this differential is between .010 and .013, but *in no case should backlash drop below the minimum figure stamped on the back of each ring gear.*

k. If the backlash figure is greater than .013 in., loosen the plain-half locknut (28) and tighten the flange-half locknut (29) by the same amount (it may be necessary to loosen the bearing-cap screws slightly to permit the locknuts to turn). Adjust the locknuts in one-notch increments until proper backlash is obtained. If backlash is below the minimum marked on the ring gear, back the flange-half locknut off, one notch at a time, and tighten the plain-half locknut in the same manner until backlash is correct.

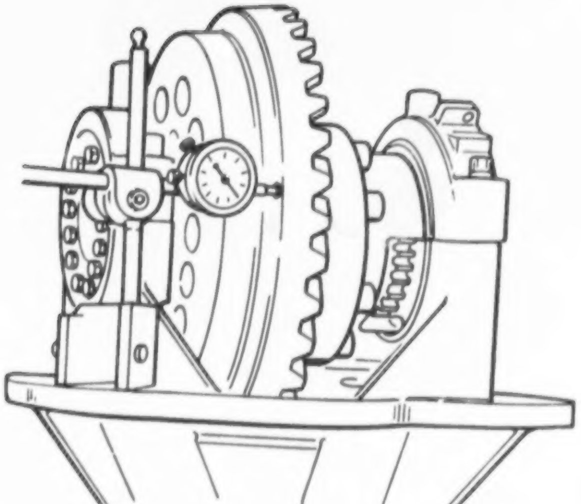


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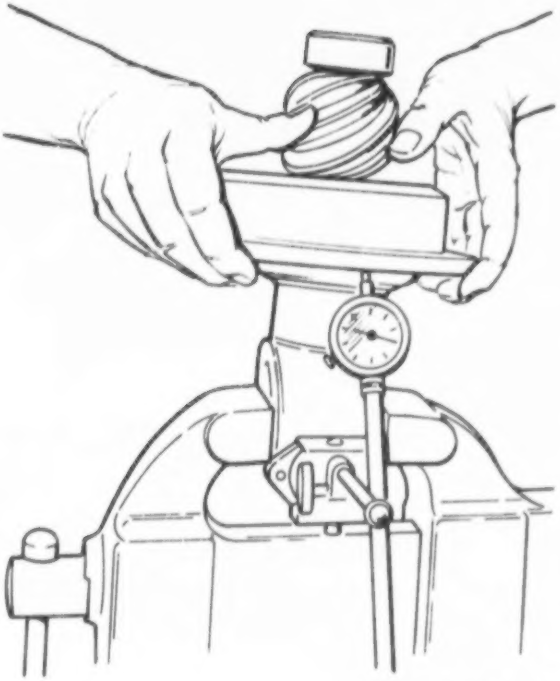
Figure 6-25. Ring-gear runout test using dial indicator.



MEC3805-240-35/6-26

Figure 6-26. Pinion-spacer thickness test, using dial indicator.

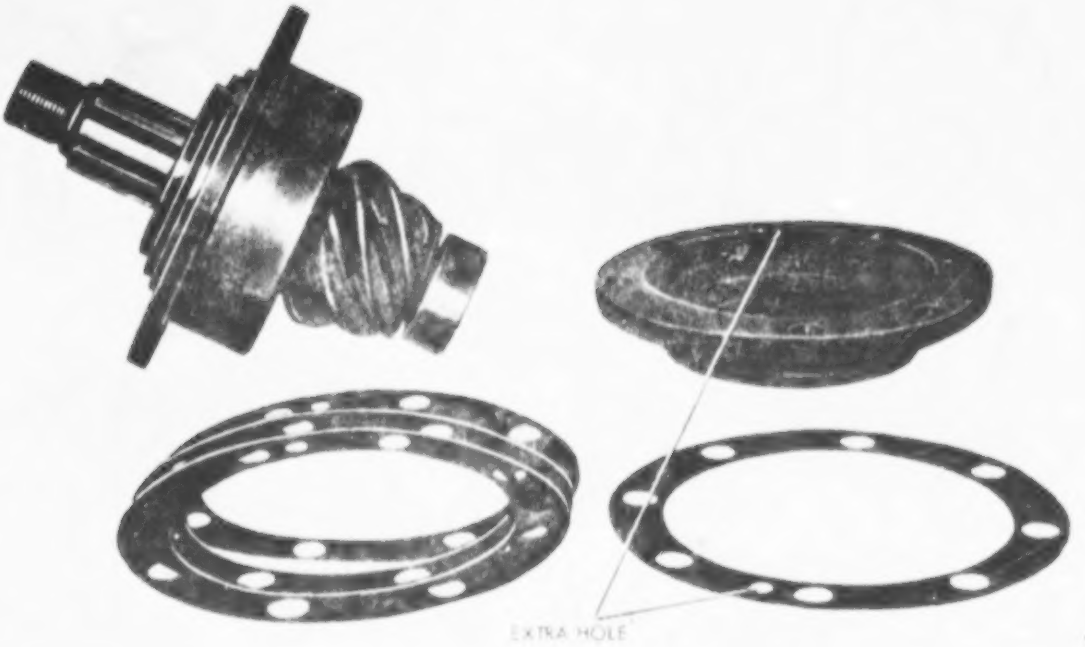
l. When correct backlash has been obtained, torque the bearing-cap socket-head screws to 330–350 ft-lbs. and test whether backlash is still within limits. If the backlash has shifted beyond the maximum or minimum tolerance, correct it until a proper backlash reading can be obtained with the bearing-cap screws at full torque.

m. Attach a spring scale to one of the nuts (39) on the back of the ring gear. Start ring gear by hand, then continue turning it by pulling on spring scale. The correct scale reading is between 6 and 11 lbs. (25–50 in-lbs.). If the scale reads less than six lbs., tighten both locknuts equally, one notch at a time, until correct preload is achieved. If the scale reads higher than 11 lbs., loosen both locknuts equally, one notch at a time, until the reading drops into the correct range. Check backlash once more after bearing-cap screws have been torqued up and repeat adjustments as necessary.

n. Paint the ring-gear teeth with red lead or a substantial equivalent. Place as much drag on the ring gear as possible by hand and rotate the pinion until the ring gear has made several turns in each direction. The correct tooth pattern is that shown in *a* and *b*, figure 6-28. The chief characteristic of the correct tooth pattern is that the pinion marks appear almost directly opposite each other on both the concave and convex sides of the ring-gear teeth. The marks should begin about 1/8 in. from the toe of the teeth. If the marks are correct, make no changes in the size of the shim cluster.

o. If the tooth pattern resembles that shown in *c* and *d*, figure 6-28, too many shims have been used, and the pinion is not reaching far enough into the ring gear. There are two characteristics to this pattern: the marks are in the correct position on the concave side of the tooth but begin too far toward the heel on the convex side; and the marks on both sides are not deep enough: they touch only the top of each tooth. Correct this condition by removing the pinion assembly and removing enough shims to produce a correct pattern.

p. If the tooth pattern resembles that shown in *e* and *f*, figure 6-28, the shim cluster is too thin and the pinion is protruding too far into the ring-gear teeth. The chief characteristic of this condition is the depth of the pinion pattern:



MEC3805-240-35/6-27

Figure 6-27. Pinion assembly and shims, showing extra lubrication hole.

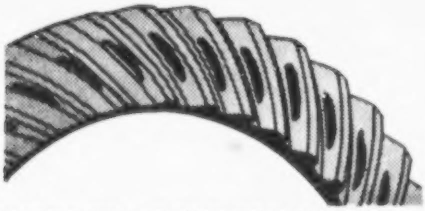
the marks begin too far from the toe of the tooth and do not touch the top of the tooth. Correct this condition by adding sufficient shims.

q. Recheck backlash. When all tests have been completed and correct readings obtained, make sure the bearing-cap socket-head screws are torqued to 330-350 ft-lbs. Using 14-gage safety wire, connect the top and bottom screws on the left side (27) to each other. Connect the top and bottom screws on the right side (26) in the same manner (fig. 6-22). Install the side-bearing adjusting locks (24, 25) and torque the adjusting-lock capscrews (22, 23) to 27-32 ft-lbs. Using 14-gage safety wire, secure the capscrew heads to the adjusting locks (fig. 6-22, 6-23).

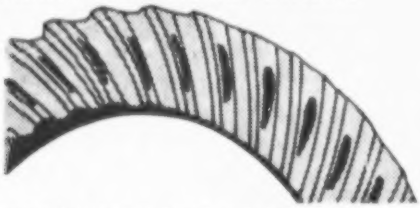
r. Adjust the oil scoop (54) so that it just touches the ring gear. Insert the set screw (52) and install the jam nut (53) on the screw. Tighten until oil scoop is held steady. Insert and tighten oil-scoop pipe plug (51). Insert and tighten the two pipe plugs (50) on the side of the carrier.

s. Refer to paragraph 2-44 and install the carrier assembly in the axle housing. During installation the lockwashers (2) and cap-screws (1) securing the carrier to the axle housing are installed. If the axle assembly was also removed from the ditcher, refer to paragraph 2-46 and install the axle housing assembly.

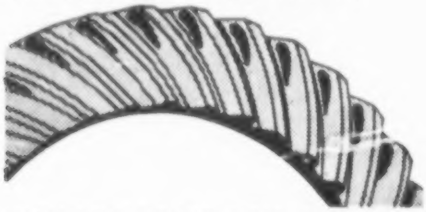
t. Install magnetic drain plug (57) at bottom of axle housing and relief fitting (56) on top of housing. If planetaries are installed, fill the differential with lubricating oil (LO 5-3805-240-12) through the lubrication hole in the side of the carrier. Install the level plug (55).



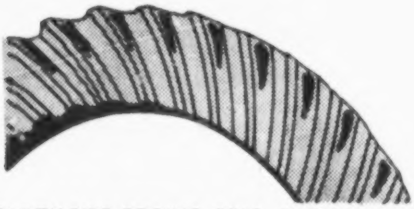
A. CONCAVE SIDE OF RING-GEAR TEETH, SHOWING CORRECT PINION PATTERN.



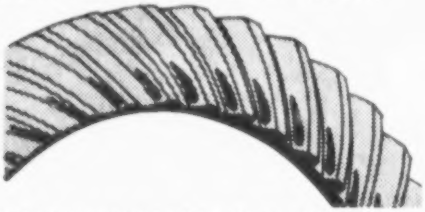
B. CONVEX SIDE OF RING-GEAR TEETH, SHOWING CORRECT PINION PATTERN.



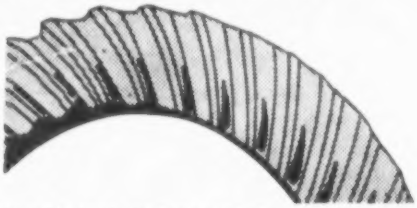
C. CONCAVE SIDE OF RING GEAR, SHOWING INSUFFICIENT PENETRATION OF PINION.



D. CONVEX SIDE OF RING GEAR, SHOWING INSUFFICIENT PENETRATION OF PINION.



E. CONCAVE SIDE OF RING GEAR, SHOWING EXCESSIVE PINION PENETRATION.



F. CONVEX SIDE OF RING GEAR, SHOWING EXCESSIVE PINION PENETRATION.

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Figure 6-28. Ring-gear wear patterns

Section V. REAR DIFFERENTIAL ASSEMBLY

6-14. Disassembly

Disassemble the rear differential in the numerical order shown in figure 6-29. Refer to *a* through *g*, paragraph 6-10.

6-15. Cleaning

Refer to *a* through *c*, paragraph 611.

6-16. Inspection and Repair

Refer to *a* through *i*, paragraph 6-12.

6-17. Reassembly

a. Refer to *a* through *e*, paragraph 6-13.

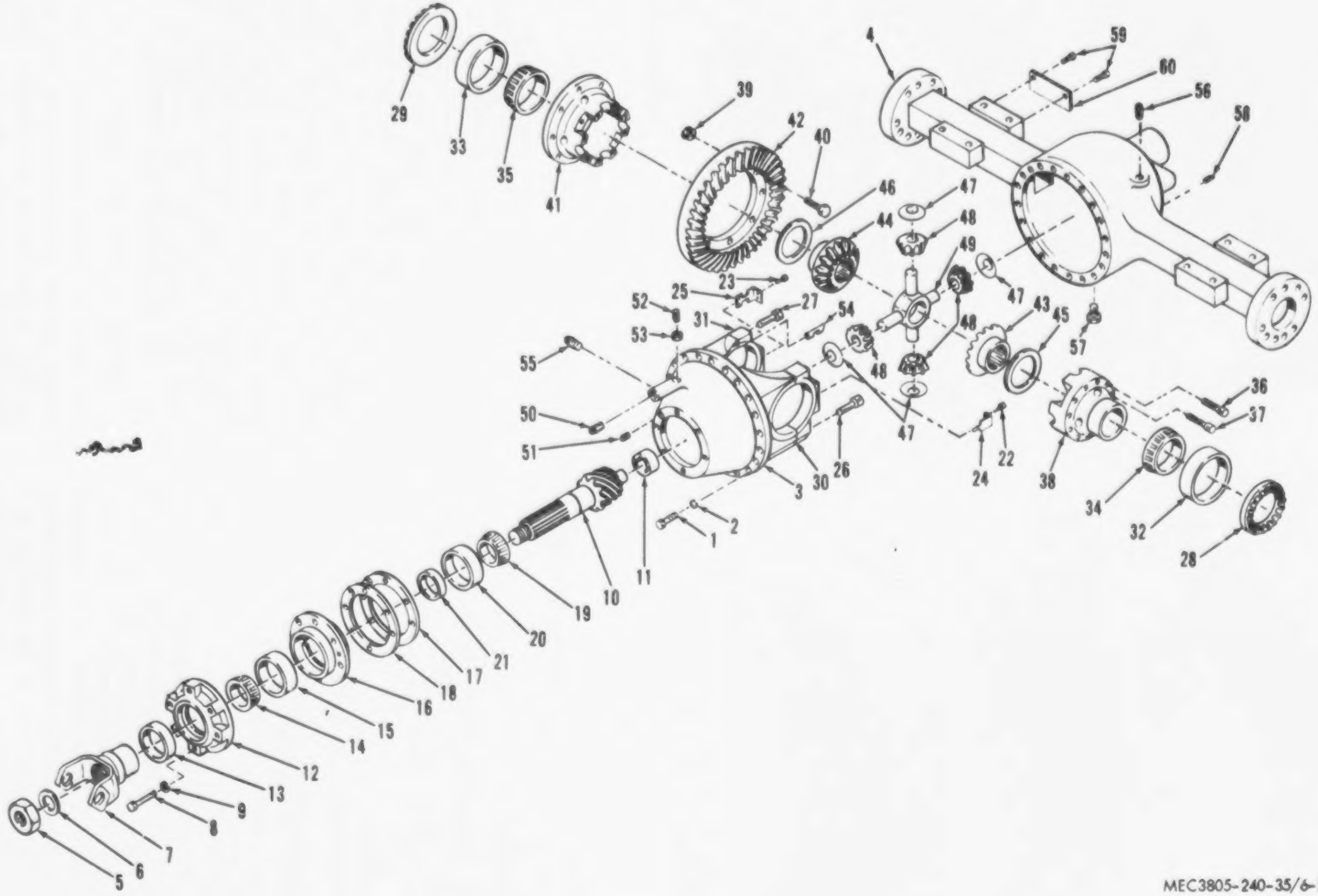
b. Assemble the inner pinion-bearing cone (19) and cup (20) in the bearing retainer (16). Select one of the thicker bearing spacers (21) from the spacer kit and install it in the middle of the bearing retainer. Install the outer pinion-bearing cup (15) and cone (14) in the retainer and install the bearing assembly on the pinion (10). Install the yoke (7) on the splined end of the pinion. Attach the washer (6) and yoke nut (5) and place the assembly in a soft-jawed vise, with the vise gripping the yoke firmly. Torque the yoke nut to 900 ft-lbs.

c. Refer to *g* and *h*, paragraph 6-13.

d. Remove the yoke nut, washer and yoke. Install the pinion oil seal (13) in the oil-seal retainer (12). Install the retainer on the pinion and replace the yoke. Torque the yoke nut to 900 ft-lbs. (Hold yoke in soft-jawed vise to turn nut). Select appropriate shims (17, 18) to build up an initial shim cluster measuring .060 inches in thickness. Install shims on inner face of bearing-retainer flange. Mesh the pinion with the ring gear, install lockwashers (9) and capscrews (8) and torque the hardware to 140-160 ft-lbs.

e. Refer to *j* through *s*, paragraph 6-13.

f. Install magnetic drain plug (57) at bottom of axle housing and relief fitting (56) on top of housing. If planetaries are installed, fill the differential with lubricating oil (LO 5-3805-240-12) through the level and filler hole in the rear of the axle housing. Install pipe plug (55) and level plug (58).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MEC3805-240-35/6-29

1 Capscrew, 1/2-20 x 1 1/4 in. (20 rqr)
2 Lockwasher, 1/2 in. (20 rqr)
3 Differential carrier
4 Axle housing
5 Elastic stop nut, 1 1/4-12
6 Washer, 1 1/4 in.

Figure 6-29. Rear differential assembly, exploded view.

7	Yoke
8	Capscrew, 5/8–11 x 2 1/2 in. (6 rqr)
9	Lockwasher, 5/8 in. (6 rqr)
10	Pinion
11	Pinion pilot bearing
12	Oil-seal retainer
13	Oil seal
14	Outer pinion-bearing cone
15	Outer pinion-bearing cup
16	Bearing retainer
17	Shim, .005 in. (as rqr)
18	Shim, .010 in.
19	Inner pinion-bearing cone
20	Inner pinion-bearing cup
21	Bearing spacer
22	Socket-head capscrew, 3/8–16 x .62 in.
23	Socket-head capscrew, 3/8–16 x .62 in.
24	Adjusting lock
25	Adjusting lock
26	Socket-head bearing-cap screw, 3/4–10 x 4 in. (2 rqr)
27	Socket-head bearing-cap screw, 3/4–10 x 4 in. (2 rqr)
28	Side-bearing locknut
29	Side-bearing locknut
30	Bearing cap
31	Bearing cap
32	Side-bearing cup
33	Side-bearing cup
34	Side-bearing cone
35	Side-bearing cone
36	Socket-head capscrew, 1/2–13 x 2 3/4 in. (8 rqr)
37	Socket-head capscrew, 1/2-13 x 3 1/2 in. (4 rqr)
38	Differential case, plain half
39	Nut, 1/2–20 (12 rqr)
40	Capscrew, 1/2–20 x 2 in. (12 rqr)
41	Differential case, flange half
42	Ring gear
43	Side gear
44	Side gear
45	Side-gear thrust washer
46	Side-gear thrust washer
47	Spider-gear thrust washer (4 rqr)
48	Spider gear (4 rqr)
49	Spider
50	Pipe plug, 1/8 in. NPT (2 rqr)
51	Oil-scoop pipe plug, 3/4 in. NPT
52	Set screw, 1/4–20 x 5/8 in.
53	Jam nut, 1/4–20
54	Oil scoop
55	Level plug
56	Relief fitting, 1/8 in. NPT
57	Magnetic drain plug, 3/4 in. NPT
58	Level plug, 3/4 in. NPT
59	Drive screw (2 rqr)
60	Name plate

Figure 6–29—Continued

Note. The front and rear differential assemblies are virtually the same in all respects; however, the rear differential assembly differs from the front in the following areas: the relief fitting (56) is slightly inboard on the axle housing; the yoke nut (5) is torqued to 900 ft-lbs. instead of 750 ft-lbs. and the rear differential has an extra level plug (58) for lubricating the assembly. Be sure the oil level reaches the bottom of the plug at the rear of the axle housing.

Section VI. RIGHT-ANGLE SPROCKET DRIVE

6-18. Disassembly

a. Removal. Refer to TM 5-3805-240-12 and remove the drive chain and paragraph 2-54 and remove the sprocket-drive assembly from the boom guide. When sprocket-drive assembly has been removed, disassemble it in the numerical order shown in figure 6-30.

Note. During removal of the sprocket-drive assembly from the boom guide, the axle-shaft assemblies (3, 6) and the capscrews (1, 4) and lockwashers (2, 5) securing them are removed from the axle housing (7). When the whole sprocket-drive assembly has been removed from the boom guide, resume disassembly by stripping the axle-shaft assemblies.

b. From each axle shaft (3, 6), remove five nuts (8, 20) from face of sprocket (9, 21) and remove sprocket. Remove self-locking hub nut (10, 22) and washer (11, 23) and remove hub (12, 24). If necessary, remove and replace damaged studs (13, 25). Remove wear sleeve (14, 26) from outer oil seal (15, 27) and remove oil seal from bearing cap (16, 28). Remove bearing cap, gasket (17, 29), bearing set (18, 30) and inner oil seal (19, 31).

c. Remove 16 nuts (32) and lockwashers (33) from face of differential carrier (34). Insert a pair of 7/16-20 capscrews in the puller holes on the face of the carrier and turn alternately, one turn at a time, until the plastic gasket is broken and the carrier is freed from the axle housing (7). Use a suitable hoist to lift the carrier onto a worktable. If necessary, remove and replace any damaged studs (35) from the axle housing.

d. Remove the pinion-yoke elastic stop nut (36) and washer (37) and remove the yoke from the pinion. Remove eight capscrews (39) and lockwashers (40) from pinion-bearing retainer (44). Remove pinion assembly (41) from carrier and remove pinion pilot bearing (42). Remove oil seal (43) and bearing retainer (44) and remove seal from retainer. Remove gasket (45), bearing housing (46) and shims (47, 48). Remove inner and outer bearing cones (49, 50), bearing spacer (51) and bearing cup (52).

Note. Be sure to record the number and size of the shims removed during this step.

e. Remove roll pins (53, 54) and side-bearing adjusting locks (55, 56). Cut the lockwires securing the socket-head capscrews (59, 60) together on the rear of the side bearing caps (61, 62). Loosen the screws slightly and remove the side bearing locknuts (57, 58). Then remove the bearing-cap screws completely and remove the bearing caps.

f. Remove the side-bearing cups (63, 64) and cones (65, 66) from both halves of the differential case. Cut the lockwires securing the four socket-head capscrews (67) and remove them from the differential case. Remove the eight self-locking nuts (68) from behind the ring gear on the flange half of the differential case and remove the eight bolts (69). Remove the plain half (70) of the differential case. Remove the ring gear and flange half of the differential case (71 through 73) as an assembly.

Note. The ring gear and flange half are secured together by rivets and need not be disassembled unless they are defective. Refer to paragraph 6-20*a* for inspection and repair procedures for this assembly.

g. Remove side gears (74, 75) from both halves of the differential case. Remove thrust washers (76, 77) from side gears. Remove spider thrust washers (78) from spider gears (79) and remove gears from spider (80).

h. Remove magnetic drain plug (81) from bottom of axle housing and level plug (82) from rear of axle housing. Remove grease fittings (83, 84) from the tunnels of the axle housing. Remove the relief fitting (85) from the left tunnel of the housing. Do not remove drive screws (86) or name plate (87) unless necessary.

6-19. Cleaning

a. Clean all metal parts in approved solvent and dry thoroughly.

b. Clean all bearings by immersing them in approved solvent and drying with compressed air.

Note. Do not spin bearing rollers. For instructions concerning proper handling of bearings, refer to TM 9-214.

c. Remove all metallic particles from the magnetic drain plug.

6-20. Inspection and Repair

a. Inspect the ring-gear/flange-half assembl (71 through 73) for cracks, breaks, distorti loss of alinement and loose rivets. Inspect the ring-gear teeth for spalling, pitting, flaking, scoring, excessive wear, discoloration and breaks. Examine all screw threads for breaks and stripping. Replace a defective flange half or ring gear. Separate ring gear (72) from flange half (73) by drilling the heads off the rivets (71) and removing the rivets. Drive or press the rivets out; do not use a chisel to remove them. Heat new rivets to a cherry-red color and install ring gear on flange half by pressing the rivets into place.

Note. Ring gears and pinions are manufactured in matched sets and must be replaced at the same time. Do not retain the old pinion when a new ring gear is installed.

b. Inspect all threaded hardware for broken or chipped threads and bent, cracked or broken shanks. Discard and replace damaged hardware.

c. Inspect the yoke and hub nuts for loss of elasticity. Discard and replace a defective nut.

d. Inspect all castings and forgings for breaks and cracks, using dye-staining and other commercial processes, if equipment is available. Inspect threads in castings for breaks and stripping. Discard and replace castings and forgings which have become cracked or suffered thread damage.

e. Discard and replace all oil seals.

f. Inspect all gear teeth and splined shafts for chipping, cracking, spalling, pitting, flaking, scoring and discoloration. Replace all defective gears and splined shafts.

g. Inspect adjusting locks for cracks, breaks, and loss of strength or alinement. Discard and replace defective adjusting locks.

h. Inspect shims for cracks and breaks. Discard damaged shims, but be sure to replace them with shims of the same thickness.

i. Inspect all bearings for alinement of rollers and races. Check for noisy or uneven operation. Inspect rollers and races for brinelling, pitting, corrosion and scratching. Discard and replace damaged bearings (Refer to TM 9-214 for detailed instructions on bearing inspection).

6-21. Reassembly

a. Lubricate the spider gears (79) with axle lubricant (LO 5-3805-240-12) and assemble them on the spider (80). Install the spider thrust washers (78) on the gears.

b. Install the side-gear thrust washers (76, 77) on the side gears (74, 75). Install gears with washers in the plain half (70) and the flange half (73) of the differential case. Lay the flange-half/ring-gear assembly (71 through 73) with side gear inside, on a flat surface with the ring-gear teeth facing upward. Place the spider assembly on top of the side gear in the flange half. Place the plain half of the differential case, including the side gear over the flange half and install the four capscrews (67) to secure the halves together. Torque the capscrews to 45-52 ft-lbs. Install the eight bolts (69) and self-locking nuts (68) and torque the nuts to 50-58 ft-lbs. Install 14-gage safety wire on capscrew heads and connect the screws to one another.

c. Install the side-bearing cones (65, 66) and cups (63, 64) on the outer ends of the differential case. Place the assembled case in the carrier (34). Position the side-bearing caps (61, 62) against the rear of the carrier. Install the bearing cap socket-head screws (59, 60) and turn them finger-tight. Install the side-bearing locknuts (57, 58) and tighten them until end play is eliminated from the differential case.

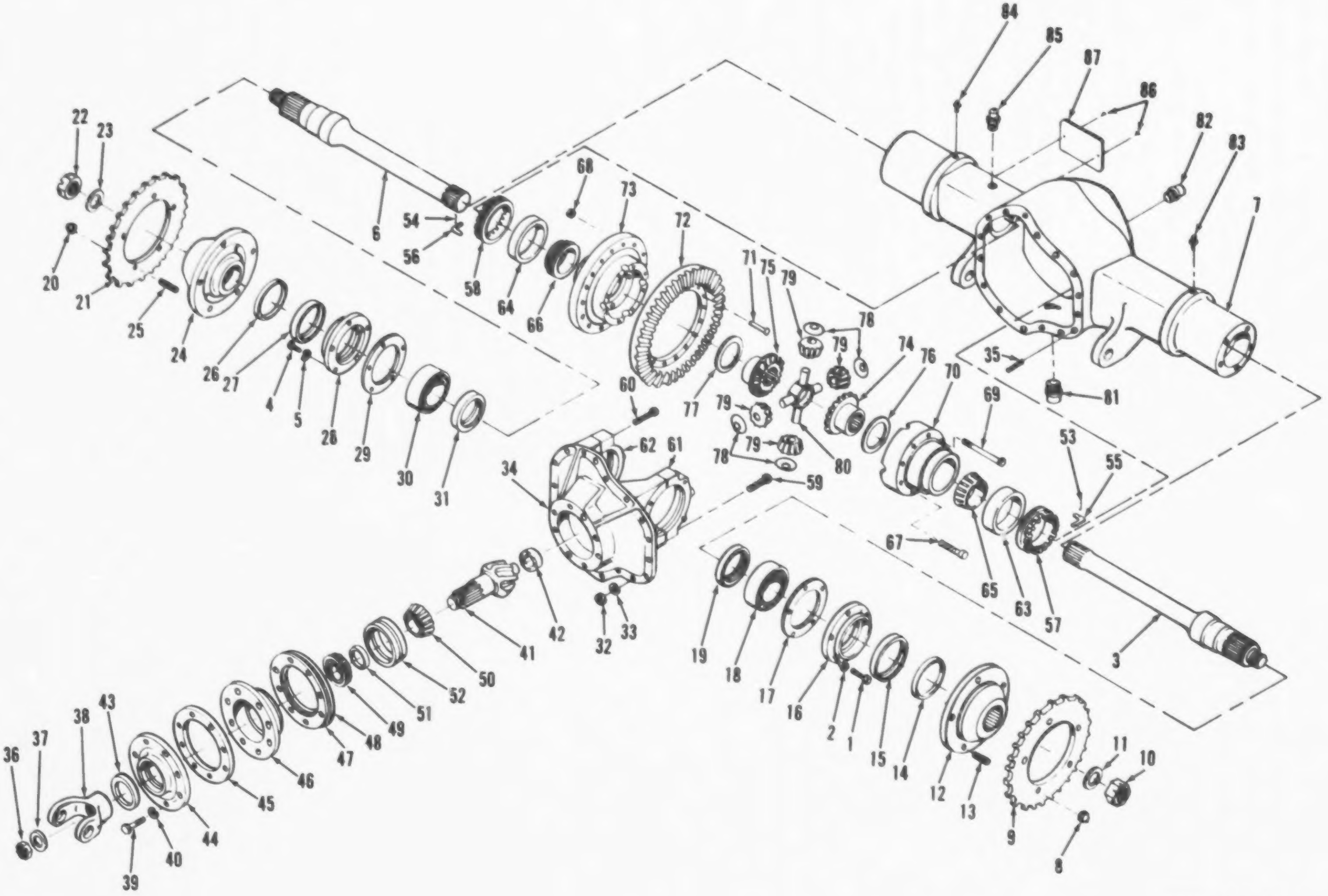
d. Attach the manufacturer's special jig, known as a "bridge", (para 2-54) to the carrier assembly. Aline the dowels on the bearing caps so that they fit into the holes in the bridge.

Note. Be sure the carrier is positioned in the bridge whenever any adjustments or measurements are performed. The bridge will hold the carrier rigid by gripping the bearing-cap dowels in the same manner as does the axle housing when the sprocket drive is fully assembled.

e. Attach a dial indicator firmly to the differential carrier (fig. 6-25) and place the plunger in contact with a smooth surface on the back of the ring gear. Rotate the ring gear and note any variations on the dial. Maximum permissible runout is .005 inches runout in excess of this figure indicates the carrier has become distorted. Replace a defective or damaged carrier.

f. Select one of the thicker spacers (51) from the spacer kit and install it in the middle of the pinion bearing cup (52). Install the inner (50) and outer pinion bearing cone (49) in the cup and install the entire bearing assembly in the bearing housing (46). Install the bearing housing and its contents over the pinion (41). Install the yoke (38), washer (37) and elastic stop nut (36) on the outer end of the pinion. Place the assembly in a soft-jawed vise, with the vise gripping the yoke firmly. Torque the nut to 750 ft-lbs.

Note. Do not install the pinion oil seal or the pinion-bearing retainer as part of this step. These parts are to be installed only after the proper tests for pinion-bearing preload have been completed. These tests are described below and must be followed precisely in order to achieve correct bearing preload and good bearing performance.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1 Capscrew, 3/8-16 x 1 in. (5 rqr)
2 Lockwasher, 3/8 in. (5 rqr)
3 Long axle shaft
4 Capscrew , 3/8-16 x 1 in. (5 rqr)
5 Lockwasher, 3/8 in. (5 rqr)
6 Short axle shaft

Figure 6-30. Right-angle sprocket-drive assembly, exploded view.

7 Axle housing
8 Self-locking nut, 5/8-18 (5 rqr)
9 Sprocket
10 Elastic stop nut, 1 1/4-12 (5 rqr)
11 Washer, 1 1/4 in.
12 Hub
13 Stud, 5/8-18 x 2 1/2 in. (5 rqr)
14 Wear sleeve
15 Outer oil seal
16 Bearing cap
17 Gasket
18 Bearing set
19 Inner oil seal
20 Self-locking nut, 5/8-18 (5 rqr)
21 Sprocket
22 Elastic stop nut, 1 1/4-12
23 Washer, 1 1/4 in.
24 Hub
25 Stud, 5/8-18 x 2 1/2 in. (5 rqr)
26 Wear sleeve
27 Outer oil seal
28 Bearing cap
29 Gasket
30 Bearing set
31 Inner oil seal
32 Nut, 7/16-20 (16 rqr)
33 Lockwasher, 7/16 in. 16 rqr)
34 Carrier
35 Stud, 7/16-20 x 2 in. (16 rqr)
36 Elastic stop nut, 1 1/4-12
37 Washer, 1 1/4 in.
38 Yoke
39 Capscrew, 1/2-13 x 1 1/2 (8 rqr)
40 Lockwasher, 1/2 in. (8 rqr)
41 Pinion
42 Pinion pilot bearing
43 Oil seal
44 Bearing retainer
45 Gasket
46 Bearing housing
47 Shim, .005 in. } (as rqr)
48 Shim, .010 in. }
49 Outer pinion bearing cone
50 Inner pinion bearing cone
51 Pinion bearing spacer
52 Pinion bearing cup
53 Roll pin
54 Roll pin
55 Adjusting lock
56 Adjusting lock
57 Side-bearing locknut
58 Side-bearing locknut
59 Bearing-cap socket-head screw, 5/8-11 x 2 3/4 in. (2 rqr)
60 Bearing-cap socket-head screw, 5/8-11 x 2 3/4 in. (2 rqr)
61 Bearing cap
62 Bearing cap
63 Bearing cup
64 Bearing cup
65 Bearing cone
66 Bearing cone
67 Socket-head capscrew, 7/16-14 x 3 1/2 in. (4 rqr)
68 Self-locking nut, 7/16-20 (8 rqr)
69 Bolt, 7/16-20 x 4.87 in. (8 rqr)
70 Differential case, plain half
71 Rivet, 1/2 x 2 1/4 in. (12 rqr)
72 Ring gear
73 Differential case, flange half
74 Side gear
75 Side gear
76 Side-gear thrust washer
77 Side-gear thrust washer
78 Spider thrust washer (4 rqr)
79 Spider gear (4 rqr)
80 Spider
81 Magnetic drain plug, 1 in. NPT
82 Level and filler plug, 1 in. NPT
83 Grease fitting, 1/8 in. NPT
84 Grease fitting, 1/8 in. NPT
85 Relief fitting, 1/8 in. NPT
86 Drive screw (2 rqr)
87 Name plate

Figure 6-30—Continued

g. Refer to *g*, paragraph 6-13, and figure 6-26.

h. Refer to *h*, paragraph 6-13, and test pinion bearing for a turning torque of 10-20 in-lbs.

i. Remove the yoke nut, washer and yoke. Install a new pinion oil seal (43) in the bearing retainer (44). Install the gasket (45) between the bearing retainer and the bearing housing. Install the yoke, washer and yoke nut and torque the nut to 750 ft-lbs. Hold the yoke in a soft-jawed vise to turn the nut. Install the pinion pilot bearing (42) in its shoulder in the carrier.

j. Select appropriate shims (47, 48) to build up a shim cluster on the inner face of the bearing-retainer flange (46). If the same ring-gear/pinion set is being used, install the same number and size of shims as were found when the pinion was disassembled. If a new ring gear and pinion have been installed, start with a shim cluster measuring .050 inches thick. Mesh pinion with ring gear, install lockwashers (40) and capscrews (39) and torque hardware to 70-80 ft-lbs.

***Caution:* Before final installation of shims and pinion assembly, be sure the extra lubrication hole in the shims and bearing-retainer flange (fig. 6-27) is aligned with the corresponding hole in the carrier casting.**

k. Refer to *j*, paragraph 6-13.

l. Refer to *k*., paragraph 6-13.

Note. Disregard the callout numbers in paragraph 6-13; the locknuts on the sprocket-drive assembly are numbered 57 (plain half) and 58 (flange half).

m. Refer to *l*, paragraph 6-13.

n. Wind a string several times around the flange side of the differential case at its greatest diameter—just behind the ring gear. Attach the end of the string to a spring scale. Start the ring gear turning by hand, then continue to turn it by pulling evenly with the spring scale. The correct reading on the scale is between 1.8 and 3.7 lbs. (10-20 ft-lbs). If the scale reads less than 1.8 lbs., tighten both side-bearing locknuts equally, one notch at a time, until the reading rises into the correct range. If the scale reads higher than 3.7 lbs., loosen both locknuts equally, one notch at a time, until the reading drops back into range. Torque the bearing-cap screws to 330-350 ft-lbs. and check whether backlash has changed during preload adjustments. Repeat backlash and preload corrections as necessary.

o. Refer to *n*, paragraph 6-13.

p. Refer to *o*, paragraph 6-13.

q. Refer to *p*, paragraph 6-13.

r. Recheck backlash. When all tests have been completed and correct readings obtained, make sure the bearing-cap socket-head screws (59, 60) are torqued up to 330-350 ft-lbs. Use 14-gage safety wire to connect the top and wire outside the assembly and over the side-bearing locknuts (fig. 6-22, 6-33). Install the side-bearing adjusting locks (55, 56) and the roll pins (53, 54).

s. Remove the carrier assembly from the bridge. Install studs (35) in the face of the axle housing (7). Apply plastic gasket compound to face of axle housing and inside of carrier flange. Use a suitable lifting device to position the carrier on the studs. Install lockwashers (33) and nuts (32). Torque hardware to 50-58 ft-lbs.

Note. When applying plastic gasket, be certain the compound does not touch any threaded holes, screw threads, gear teeth or other delicate, machined surfaces. Confine the gasket compound to mating surfaces.

t. Install the magnetic drain plug (81) on bottom of axle housing and level and filler plug (82) at rear of axle housing. Install grease fittings (83, 84) on outer tunnels of axle housing and relief fitting (85) just outboard of differential.

u. On each axle-shaft assembly, apply a coating of grease (GAA) to the lips of the inner axle-shaft oil seals (19, 31) and install each seal in its shoulder on the axle shaft (3, 6). Install the axle-shaft bearing set (18, 30) on the outer ends of the axles. Install gasket (17, 29) over outer end of bearing set and install outer oil seal (15, 27) in the bearing cap (16, 28). Apply a coating of grease (GAA) to the oil seal. Install the seal and bearing cap on the axle shaft. Install the five studs (13, 25) in the hub (12, 24) and install wear sleeve (14, 26) in hub. Install hub on axle-shaft splines. Install sprocket (9, 21) on hub studs and torque the five sprocket nuts (8, 20) to 160-180 ft-lbs. Install washer (11, 23) on end of axle shaft. Install self-locking nut (10, 22) to end of axle-shaft and torque to 750 ft-lbs.

v. Refer to paragraph 2-56 and proceed in reverse order to install axle-housing assembly in boom guide. When axle-housing assembly has been positioned in the flange bearing and bushing, install the axle-shaft assemblies in the axle housing. Install the bearing-cap lockwashers (2, 5) and capscrews (1, 4) and torque the hardware to 27-32 ft-lbs. Refer to TM 5-3805-240-12 and install drive chain. Refer to LO 5-3805-240-12 and lubricate the sprocket-drive assembly.

CHAPTER 7

STEERING SYSTEM REPAIR INSTRUCTIONS

Section I. MAIN AND STEERING HYDRAULIC PUMP

7-1. General

One element of a double-element vane-type pump supplies hydraulic fluid under pressure to a power steering gear assembly unit to provide hydraulically assisted steering.

7-2. Repair

Refer to paragraph 8-5 for repair instructions for the main and steering hydraulic pump.

Section II. POWER STEERING GEAR ASSEMBLY

7-3. General

The power steering gear assembly (fig. 7-1) provides manual steering with hydraulic assist for the ditcher. When the steering is turned, the gear box in the upper steering assembly (para 7-10) turns a double universal joint shaft which in turn rotates a threaded actuating shaft in the power steering gear assembly. The movement of the threaded shaft positions an actuating valve within the assembly to route pressurized hydraulic fluid from one element of the main and steering hydraulic pump to one side or the other of a piston. The piston moves under pressure within the assembly, and a rack integral with the piston rotates an output gear and shaft spline connected to a steering arm. The steering arm has a ball which seats in spring-loaded bearing sockets in the drag link (para 7-14) which turns the front axle sockets.

7-4. Removal

Refer to paragraph 2-43 and remove the power steering gear assembly to a clean work table.

7-5. Disassembly

Note. Items 1 through 4, figure 7-1, will have been disassembled as part of the procedure of removing the power steering gear assembly from the ditcher.

Disassemble the power steering gear assembly in the numerical sequence as illustrated on figure 7-1.

***Caution:* Benchmark all castings before removing to facilitate later reassembly.**

Note. Do not disassemble items 30, 31, 32, figure 7-1, as these items are supplied only as an assembly.

***Caution:* Matchmark actuating piston (35) and adjusting nut (45) before removing pin (36). Do not force actuating valve (39) from piston (35).**

***Caution:* Relief valve balls (42) are spring loaded. Avoid losing them when removing valve seats (41).**

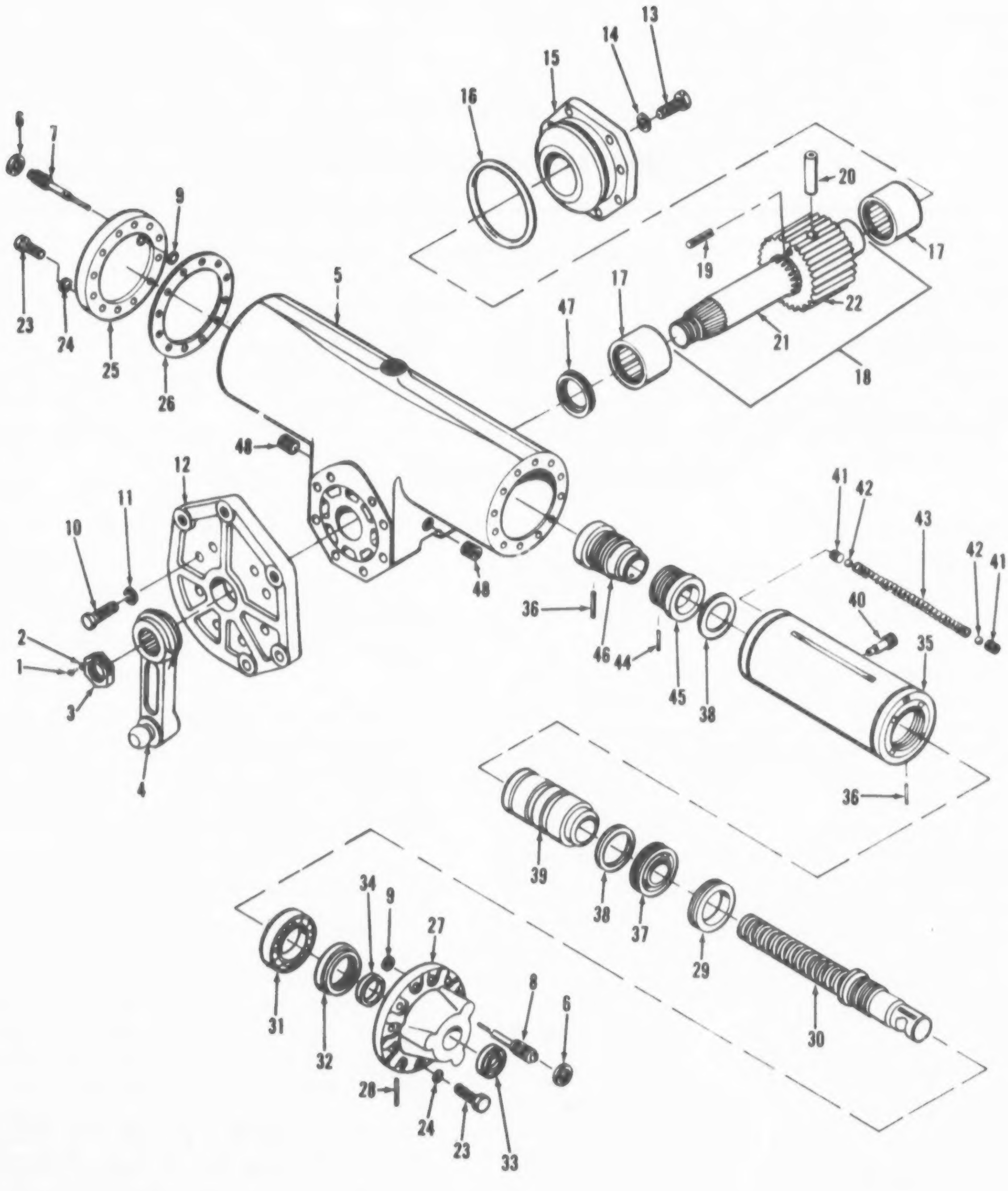
7-6. Cleaning, Inspection, and Repair

a. Clean all metal parts with approved solvent and blow dry, using moisture-free compressed air.

b. Inspect machined surfaces for nicks and burrs, especially on or near rack teeth of piston (35). Remove raised burrs by honing. Inspect castings for cracks, distortion, or damaged threads. Turn actuating shaft (30) into valve (39) to check for sticking or other evidence of damaged threads. Replace damaged parts.

c. Turn actuating shaft assembly (30) in bearing (31) to check for binding, excessive looseness, or other evidences of defective bearing. If bearing is defective, replace actuating shaft assembly.

Note. The actuating shaft (30), bearing (31), and nut (32) must be replaced as an assembly. If the actuating piston (35), valve adjusting nut (37), actuating valve (39), cylinder head adjusting nut (45), or plug (46) are damaged, replace the piston and valve assembly (Item 35 through 46) as an assembly.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MEC3805-240-35/7-1

1 Screw, cap, socket head, 5/16-24 x 3/4	3 Locknut, 1 7/8-12
2 Washer, lock 5/16	4 Arm, steering gear assembly

Figure 7-1. Power steering gear assembly, exploded view.

5	**Housing**
6	**Nut, plain, hex 3/8-24 (2)**
7	**Plunger**
8	**Plunger**
9	**Packing, preformed (2)**
10	**Bolt, machine, 5/8-18 x 1-1/2 (8)**
11	**Washer, lock, 5/8 (8)**
12	**Bracket**
13	**Bolt, 5/8-18 x 1 1/4 (8)**
14	**Washer, lock, 5/8 (8)**
15	**Cover, housing**
16	**Packing, preformed**
17	**Bearing, roller, needle (2)**
18	**Output shaft and gear assembly**
19	**Pin, spring**
20	**Pin, gear retaining**
21	**Shaft, output**
22	**Gear, output shaft**
23	**Bolt, 3/8-24 x 1 1/2 (24)**
24	**Washer, lock, 3/8 (24)**
25	**Head, cylinder**
26	**Gasket (2)**
27	**Bearing cap**
28	**Pin**
29	**Nut, bearing retainer**
30	**Shaft, actuating**
31	**Bearing, ball, annular**
32	**Nut, shaft retaining**
33	**Seal, dirt**
34	**Seal, oil**
35	**Piston, actuating**
36	**Pin (2)**
37	**Nut, valve adjusting**
38	**Spring, flat, reversing (2)**
39	**Valve, actuating**
40	**Pin, valve positioning**
41	**Valve seat (2)**
42	**Ball (2)**
43	**Spring, helical, compression**
44	**Pin, spring**
45	**Nut, adjusting, cylinder head**
46	**Plug**
47	**Seal, rubber, special shaped section**
48	**Plug, pipe, 1/4-14 NPT**

Figure 7-1—Continued

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d. Discard seals, gaskets, and preformed packing and replace with new items.

e. Inspect relief valve seats (41) and balls (42) for damaged mating surfaces. Replace damaged parts.

f. Temporarily install needle bearings (17) on journals of output shaft (21) to check for binding. Replace defective bearings or shaft.

g. Inspect relief spring (43) for broken or nicked coils. Using a spring tester, check spring for weakness (table 1-1). Replace weakened or damaged spring.

h. Inspect gear (22) for nicked, burred, or broken teeth. Inspect output shaft for nicked, burred, or broken splines. Remove small burrs by honing. Replace badly damaged parts.

i. Discard spring pins (19 and 44) and replace with new pins. Inspect lock pins (20, 28, 36 and 40) for loose fit or bent condition and replace loose or damaged lock pins.

7-7. Reassembly

Reassemble power steering gear in reverse of numerical sequence as illustrated on figure 7-1, observing the following notes and cautions.

Note. Relief valve seats (41) must be tight in piston (35) and flush with or slightly below surface of piston.

Note. Make sure reversing springs (38) are centered in bore of valve (39).

Note. Install valve positioning pin (40) in piston (35) so that flats of pin enter into piston 1/4-inch before sliding actuating valve (39) into piston. Slot on end of valve must be positioned over pin.

Note. If a new bearing retaining nut (29) is used, it must be drilled for pin (28). Install nut (29), then drill through hole in bearing cap (27) 3/16-inch into nut (29), using a 3/32-inch drill.

***Caution:* Aline reference matchmarks during reassembly. Be particularly sure that output shaft gear (22) timing mark is aligned with marked spline on shaft (21) and that marked tooth on gear (22) is alined with timing mark on rack tooth of piston (35).**

7-8. Adjustment

The power steering gear assembly requires adjustment after installation on the ditcher. Observe the adjustment instructions in paragraph 2-43.

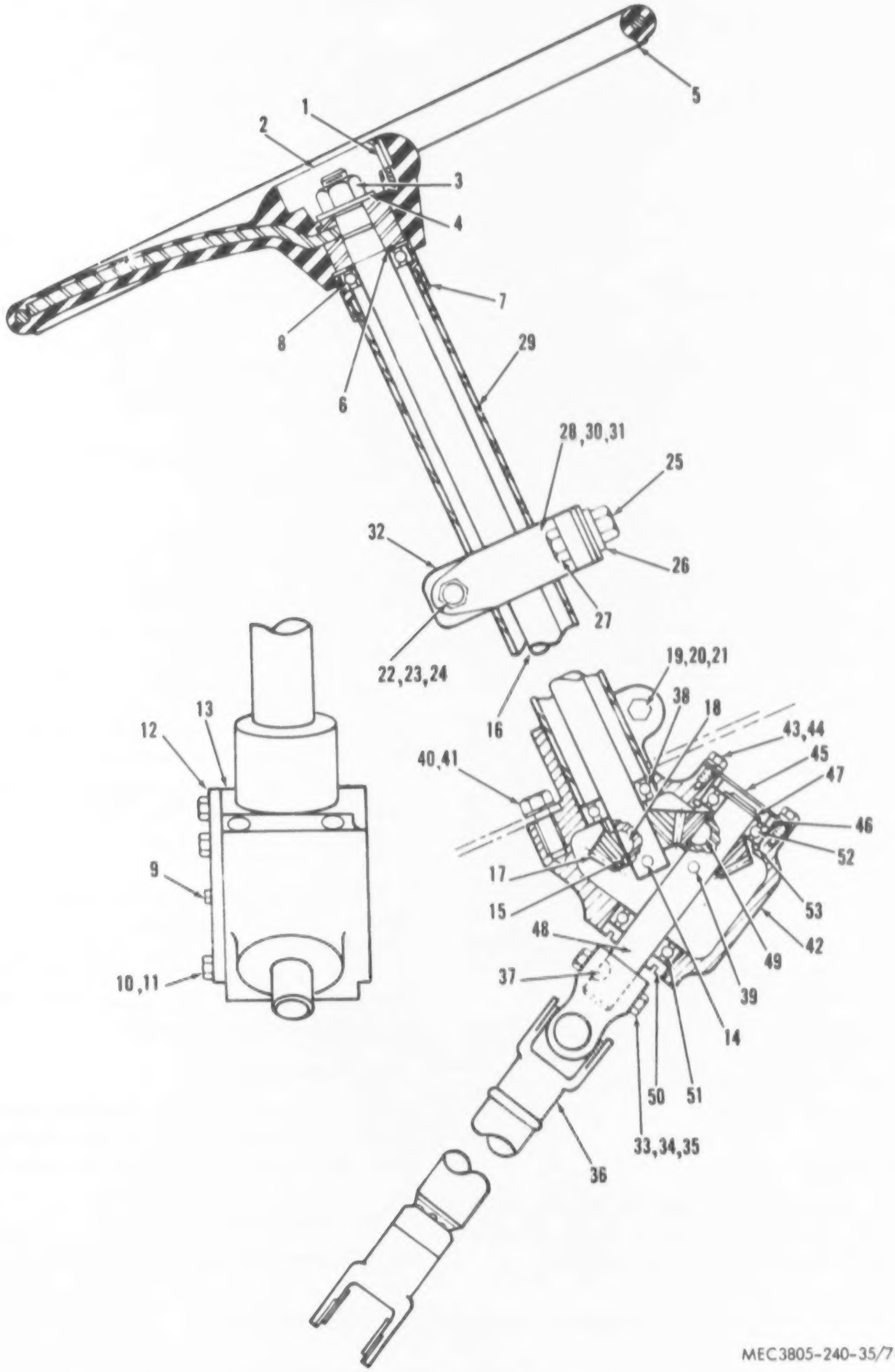
7-9. Installation

Install steering gear (para 2-43).

Section II. UPPER STEERING ASSEMBLY

7-10. General

The upper steering assembly (fig. 7-2) consists of a steering wheel and shaft connected to a gear box. Manual turning effort at the steering wheel is transmitted at an angle through the gears to the steering shaft (para 10-3), and then to the actuating shaft of the power steering gear (para 7-3).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1 Screw, tapping, thread forming #10 x 1 1/4 type "A" ctsk. oval hd. (3)
2 Cap, steering wheel
3 Nut, hex jam

Figure 7-2. Upper steering assembly, cross section view.

4 Washer, flat 3/4
5 Wheel, steering
6 Spacer, ring
7 Ring, retaining
8 Bearing, annular ball
9 Plug, pipe: sq. hd. 1/8 NPT
10 Screw, cap, hex head 1/4-20 x 1/2
11 Washer, lock 1/4 (3)
12 Cover
13 Gasket
14 Pin, spring: tubular 1/4 x 1 3/8
15 Spacer, ring 1 1/64 (as rqr)
16 Shaft
17 Gear, steering (2)
18 Key, Woodruff
19 Nut 1/2-13
20 Washer, lock 1/2
21 Screw, cap, hex head 1/2-13 x 2 3/4
22 Nut 1/2-13
23 Washer, lock 1/2
24 Screw, cap, hex head 1/2-13 x 3
25 Nut 1/2-13 (2)
26 Washer, lock 1/2 (2)
27 Screw, cap, hex head 1/2-13 x 2 (2)
28 Support (2)
29 Tube
30 Shim (as rqr)
31 Shim (as rqr)
32 Bushing, rubber
33 Nut 3/8-16 (2)
34 Washer, lock 3/8 (2)
35 Screw, cap, hex head 3/8-16 x 1 3/4 (2)
36 Universal joint assembly
37 Key, Woodruff
38 Bearing, annular ball
39 Pin, spring: tubular 1/4 x 1 3/8
40 Screw, cap, hex head 1/2-13 x 1 (2)
41 Washer, lock 1/2 (2)
42 Gearbox, steering
43 Screw, cap, hex head 1/4-20 x 1/2 (4)
44 Washer, lock 1/4 (4)
45 End piece
46 Spacer, ring
47 Ring, retaining
48 Shaft, gear box
49 Key, Woodruff
50 Seal, oil
51 Bearing, ball
52 Bearing, ball
53 Ring, retaining

Figure 7-2—Continued

7-11. Removal and Disassembly

Remove and disassemble the upper steering assembly in the numerical sequence as illustrated on figure 7-2.

Note. Record the number of shims (30 and 31) for later reassembly.

7-12. Cleaning, Inspection, and Repair

a. Clean all metal parts with approved solvent. Blow dry, using moisture-free compressed air.

Caution: **Do not spin bearings (51 and 52).**

b. Discard gaskets and preformed packings and replace with new items.

c. Discard spring pins and replace with new items.

d. Inpect machined surfaces for nicks and burrs, especially on gears (17). Remove small raised burrs by honing. Inspect castings for cracks, distortion, or damaged threads. Chase damaged threads. Replace damaged parts.

e. Inspect threaded fittings for damage and replace if necessary.

f. Rotate bearings (51 and 52) to check for sticking or excessive wear. Replace damaged or worn bearings.

g. Pack bearings with GAA and set aside temporarily in a clean area. Cover bearings with a clean cloth.

7-13. Reassembly and Installation

Reassemble and install the upper steering assembly in reverse of the numerical sequence as illustrated on figure 7-2.

Note. Use same number and thickness of shims (30 and 31) originally installed. Pack gear box (42) with GAA before installing cover (12).

Section IV. STEERING DRAG LINK

7-14. General

The steering drag link (fig. 7-3) connects the steering arms at the power steering gear assembly and the front axle assembly.

7-15. Removal and Disassembly

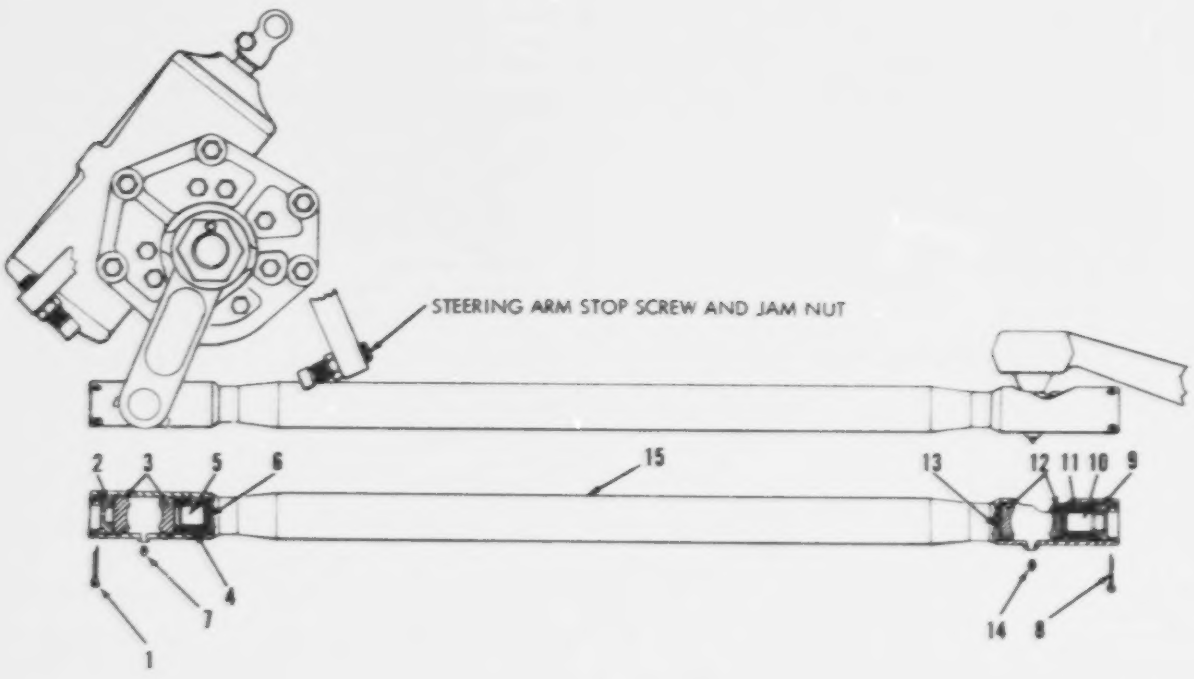
Remove and disassemble the steering drag link in the numerical sequence as illustrated on figure 7-3.

Note. Remove cotter pins (1 and 8) and turn threaded plugs (2 and 9) to permit tube assembly (15) to be slipped from the balls of the power steering gear arm and the front axle steering arm.

7-16. Cleaning, Inspection, and Repair

a. Clean all metal parts with approved solvent and blow dry, using moisture-free compressed air.

b. Inspect threaded parts for damaged threads and chase threads or replace parts as necessary.



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1	Pin, cotter
2	Plug, threaded
3	Bearing, drag link ball (2)
4	Spring, helical, compression
5	Spring bumper
6	Seat
7	Fitting, lubrication
8	Pin, cotter
9	Plug, threaded
10	Spring bumper
11	Spring, helical, compression
12	Bearing, drag link ball (2)
13	Seat
14	Fitting, lubrication
15	Tube assembly, metal

Figure 7-3. Horizontal drag link assembly, cutaway view.

c. Inspect bearings (3 and 12) for uneven wear, pitting, scoring and replace if unevenly worn, pitted, or scored.

d. Inspect springs (4 and 11) for broken or nicked coils. Replace damaged springs.

e. Inspect tube assembly (15) for kinks, bends or distorted keyhole slots. Replace a damaged tube assembly.

7-17. Reassembly and Installation

Reassemble and install the steering drag link assembly in reverse of the numerical sequence as illustrated on figure 7-3.

Note. Turn threaded plugs (2 and 9) into tube assembly only sufficiently to catch two threads. Install drag link assembly on balls of power steering gear steering arm and front axle steering arm before tightening threaded plugs and installing cotter pins (1 and 8).

CHAPTER 8

MAIN HYDRAULIC SYSTEM REPAIR INSTRUCTIONS

Section I. COMMON COMPONENTS

8–1. General

a. Subsystems. The main hydraulic system of the ditcher (fig. 8–1) comprises four subsystems which share certain common components. One subsystem is the power steering system. Repair instructions for this system are covered in paragraphs 7–2 through 7–9. Other subsystems are as follows:

(1) *Hydraulic cylinder and conveyor shift subsystem.* This system transmits power to raise and lower the digging boom assembly to tilt the boom guide assembly, to position the scraper assembly, and to shift the spoil conveyor. It consists of the following major components.

(*a*) A two-section vane-type pump. One section of the pump supplies fluid under pressure to operate the pressure-actuated devices in the system; the other section supplies fluid under pressure to the power steering gear assembly.

(*b*) A four-spool valve assembly.

(*c*) Two boom guide hydraulic cylinders.

(*d*) Two digging boom hoist hydraulic cylinders.

(*e*) The scraper hydraulic cylinder.

(*f*) The spoil conveyor shift motor.

(2) *Crowd drive subsystem.* This system powers the travel of the ditcher while digging. It consists of:

(*a*) A variable displacement pump assembly.

(*b*) A double relief and replenishing valve assembly.

(*c*) A crowd drive motor assembly.

(3) *Conveyor belt drive subsystem.* This system powers the movement of the spoil conveyor belt. It consists of:

(*a*) A variable displacement pump assembly.

(*b*) A directional control valve.

(*c*) Two gear-type conveyor belt drive motors.

b. Common Components. The various subsystems comprising the main hydraulic system use the following components in common.

(1) The hydraulic oil cooler.

(2) The in-line hydraulic filter assembly.

(3) The main hydraulic reservoir assembly.

8–2. Hydraulic Oil Cooler

a. General. An air cooler located in front of the radiator of the ditcher cools twenty-three per cent of the main hydraulic system fluid continuously when the system is in use.

b. Removal. Remove the hydraulic oil cooler (para 2–40).

c. Inspection, Repair and Testing. Refer to TM 10–450 for repair, inspection and testing instructions for the hydraulic oil cooler.

d. Installation. Install hydraulic oil cooler (para 2–40).

8–3. In-Line Hydraulic Filter

For repair instructions for this assembly, refer to TM 5-3805-240-12.

8–4. Main Hydraulic Reservoir Assembly

a. General. The main hydraulic reservoir assembly contains approximately seventy-five per cent of the seventy-five gallon capacity of the main hydraulic system. The reservoir assembly is protected by a filtered pressure-vacuum relief valve assembly. The valve relieves internal pressure and guards against system vacuum, maintaining atmospheric pressure in the reservoir. The return filter assembly screens dirt particles and other contaminants from the incoming fluid. The return filter contains a surge valve which relieves surge pressures that may occur in the return lines. An outlet filter assembly screens contamination from the fluid flowing out of the reservoir. This filter assembly contains a similar surge valve.

b. Removal. Remove the main hydraulic reservoir assembly (para 2–48).

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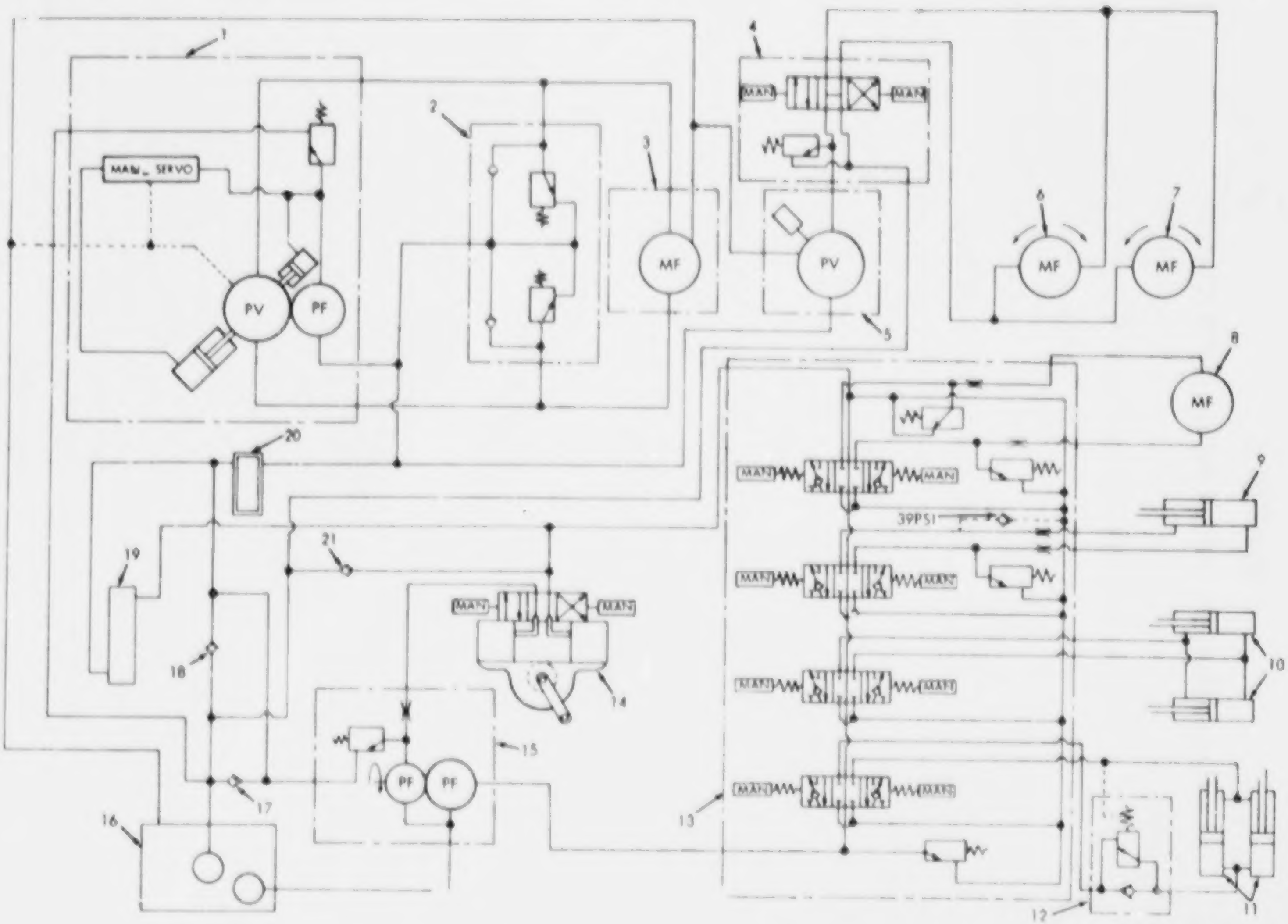
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1 Crowd drive pump
2 Double relief and replenishing valve
3 Crowd drive motor
4 Conveyor directional control valve
5 Conveyor belt drive pump
6 Conveyor belt drive motor

Figure 8-1. Main hydraulic system diagram.

7 Conveyor belt drive motor
8 Conveyor shift motor
9 Follow-up scraper cylinder
10 Boom guide cylinder (2 rqr)
11 Boom hoist cylinder (2 rqr)
12 Overcenter valve
13 Four section control valve
14 Power steering unit
15 Main and steering pump
16 Main hydraulic reservoir
17 Check valve, 15 psi
18 Check valve, 15 psi
19 Oil cooler
20 Line filter
21 Check valve, 40 psi

Figure 8-1—Continued

Note. Before removal and cleaning, inspect tank for leaks and mark those areas where leaks are found.

c. Disassembly. Disassemble the main hydraulic reservoir assembly in the numerical sequence as illustrated on figure 8-2.

(1) Before disassembly, thoroughly clean reservoir assembly with an approved cleaning solvent and air dry.

(2) Remove pressure-vacuum relief valve and disassemble in numerical sequence as illustrated on figure 8-2. Discard all packing.

(3) Remove fluid level indicator assembly (20 through 24) and disassemble only if defective. Discard packing

(4) Remove cap assembly (14 through 17) and disassemble.

(5) Remove lock nuts, cover plate and preformed packing (4 through 6).

(6) Remove filter assembly and disassemble only if defective. Replace filter element and packings.

(7) Remove lock nuts, cover plates and packings (8 through 10). Discard packings.

d. Cleaning. Clean all parts with approved cleaning solvent and air dry. Be sure to clean inside of reservoir thoroughly. Cap all openings to prevent contamination.

e. Inspection and Repair.

(1) Inspect all threaded parts for damaged threads and replace parts if defective.

(2) Inspect cover plates for dents, warping, or cracks. Replace if defective.

(3) Inspect fluid level indicator (20) for proper operation. Replace if defective. Inspect terminal and chain (23) for wear and bent or broken links. Replace if defective.

(4) Inspect cap (14) for leaks, cracks and terminal and chain (17) for wear and bent or damaged threads. Replace if defective. Inspect broken links. Replace if defective. Replace gasket (15). Check screen (19) for dents and tears. Replace if defective.

(5) Inspect surge valve in return filter assembly. Test cracking pressure (25 psi) and check springs for cracks, breaks, or weakness. Use a spring tester if available. Replace weakened or defective parts. Replace filter element. Replace performed packing.

(6) Inspect surge valve in outlet filter assembly. Test cracking pressure (2.5 psi) and check springs for cracks, breaks, or weakness. Use a spring tester if available. Replace weakened or defective parts. Replace filter element. Replace preformed packing.

(7) Inspect pressure-vacuum relief valve assembly parts for wear, cracks, or leaks. Replace defective parts. Replace filter element and preformed packing.

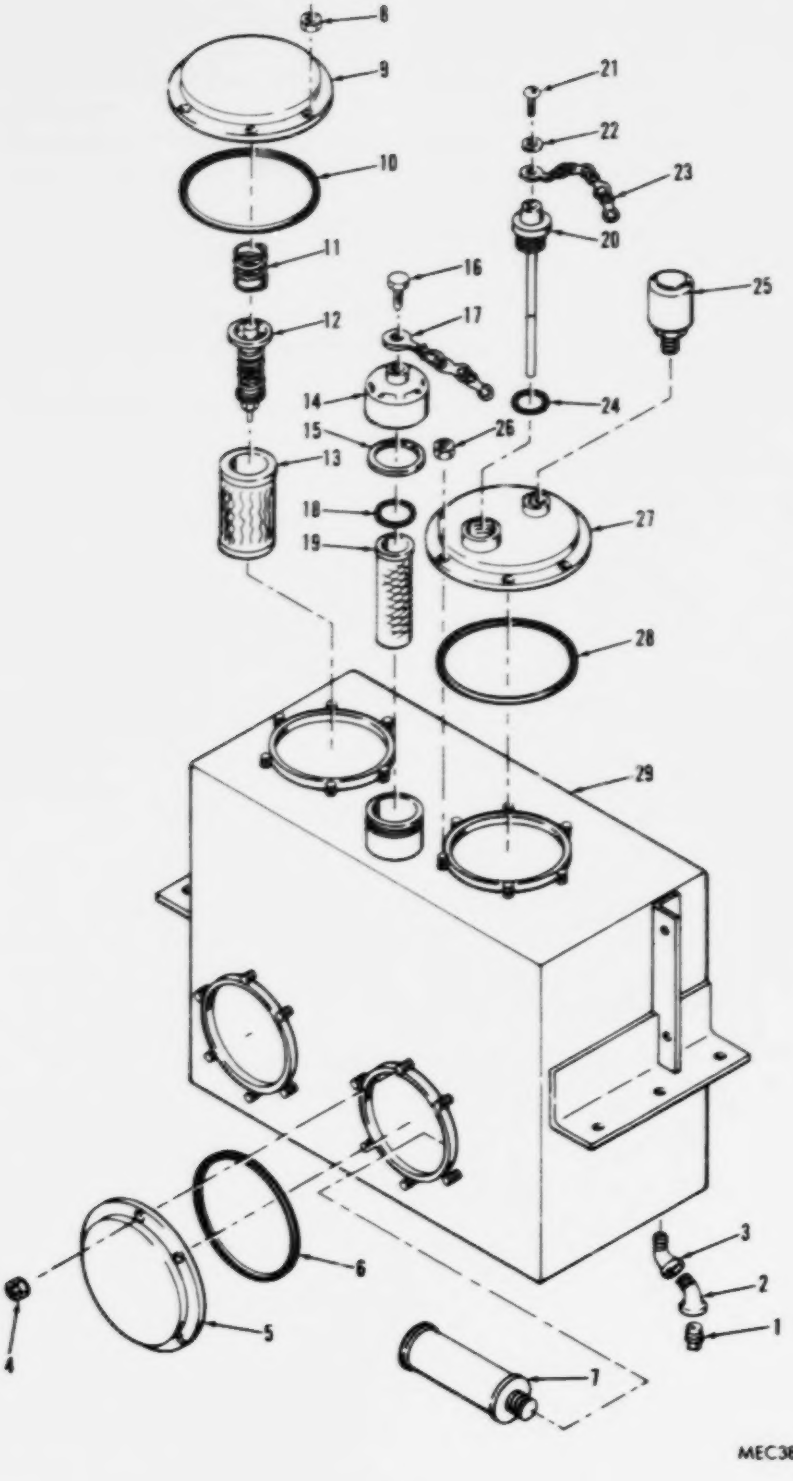
(8) Inspect reservoir assembly for cracks, bent flanges, or broken welds. Repair by welding (para 15-4) if possible. Refer to paragraph 12-4 and apply appropriate fuel-tank testing and repair procedures to the hydraulic reservoir, using figure 8-2 as a guide to disassembly and reassembly.

f. Reassembly. Reassemble the main hydraulic reservoir assembly in reverse of numerical sequence as illustrated on figure 8-2.

Note. Reassemble pressure-vacuum relief valve and test for a cracking pressure of 12 psi. If faulty, disassemble and replace packing and springs.

***Caution:* Do not use wrench on body of valve assembly to tighten.**

g. Installation. Install hydraulic reservoir (para 2-48).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1 Pipe plug, magnetic, 3/4 NPTF
2 Street elbow, 45°, 3/4 NPTF
3 Street elbow, 45°, 3/4 NPTF
4 Locknut, 5/16-18 (12 rqr)
5 Cover (2 rqr)
6 Gasket (2 rqr)

Figure 8-2. Hydraulic tank assembly, exploded view.

7 Suction filter
8 Locknut, 5/16-18 (6 rqr)
9 Cover assembly
10 Gasket
11 Hold-down spring
12 By-pass valve assembly
13 Filter element
14 Filler cap
15 Gasket
16 Screw, 5/16-18 x 1/2 in..
17 Chain assembly
18 Retaining ring
19 Screen
20 Indicator
21 Screw, 5/16-18 x 3/8 in.
22 Flat washer, 5/16
23 Chain
24 Gasket
25 Relief valve assembly
26 Locknut, 5/16-18 (6 rqr)
27 Cover assembly
28 Gasket
29 Tank assembly

Figure 8-2—Continued

Section II. HYDRAULIC CYLINDER AND CONVEYOR SHIFT SUBSYSTEM

8-5. Main and Steering Pump

a. General.

(1) The main and steering pump (fig. 8-3) is a two-element vane-type pump. One element of the pump supplies fluid under pressure to the main hydraulic system. The other element of the pump provides constant pressure to the steering gear. Excess pressure is relieved by a one-way relief valve that returns fluid to the reservoir.

(2) The two cartridges (2 and 4, fig. 8-3) are basically alike, each has a slotted rotor containing twelve vanes. Each rotor rotates within a ring having an elliptical internal surface. Centrifugal force causes the vanes to move in and out of their slots, following the internal surfaces of each ring. This forms twelve chambers within each cartridge, with their boundaries being the vanes, the ring, and the rotor. As each chamber passes the inlet port in the ring, the chamber increases in volume, drawing fluid in. As each chamber passes the outlet ports, it decreases in volume, forcing the fluid out. Two sets of outlet ports and two sets of inlet ports are used on each ring to balance out radial loads on the shaft.

(3) Fluid from the inlet body (3), after passing through the cartridges, appears at system pressure in the outlet cover (1) and the outlet body (5). The springs (6 and 10) initially hold the pressure plates (7 and 9) to prevent excessive leakage and permit pumping action. As system pressure builds up, it acts on the large exposed surfaces of the pressure plates, holding them tightly in place. The outlet cover contains a relief valve which permits desired flow to go to the steering gear and excess pressure to go to the hydraulic reservoir, (fig. 8-4). When pump delivery is below the desired flow, pressures P_1 and P_2 are essentially equal, and the spool is held in place by the spring. When pump delivery is above the desired flow, the flow control orifice creates a pressure drop and causes P_1 to be higher than P_2. This unseats the spool, allowing partial flow to the reservoir. If system pressure exceeds the relief valve setting of 2000 psi, the pilot poppet is forced open. The resulting flow through the pilot orifice creates additional pressure difference between P_1 and P_2. This moves the spool further to allow all flow to escape through the reservoir port, relieving system pressure.

b. Removal. Remove main and steering pump (para 2-48).

c. Disassembly. Disassemble the main and steering pump in the numerical sequence as illustrated on figure 8-5.

d. Cleaning. Clean all parts throroughly with an approved cleaning solvent prior to inspection and after lapping or grinding operation and air dry.

e. Inspection and Repair.

(1) Test springs, using a spring tester. Replace weak or broken springs (8 and 26, fig. 8-5).

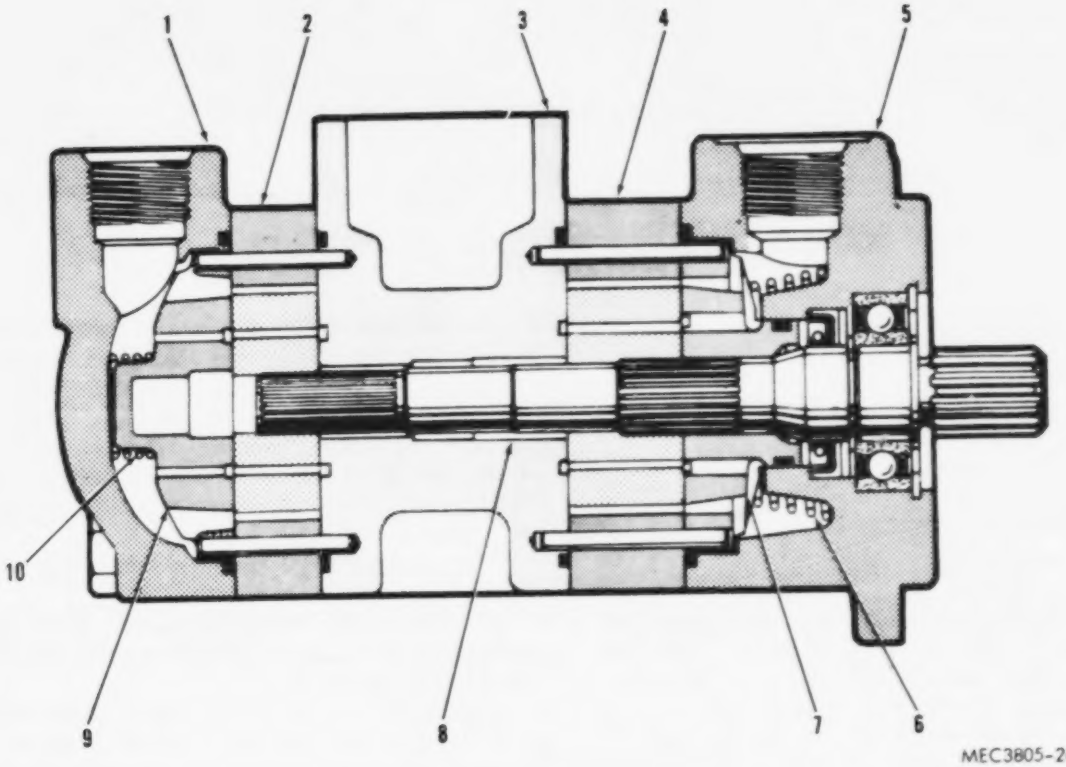
(2) Inspect the pressure plates (9 and 24) for wear and scoring and replace if severely scored or worn.

(3) Inspect the inlet body (16) on both sides for wear and scoring and replace if badly scored. A bushing (17) is included with a new inlet body.

(4) Check rings (11 and 19) and rotors (13 and 21) for wear and scoring. Lapping or light grinding of these parts is permissible. If these parts are badly worn or scored, replace with a cartridge kit consisting of a ring, rotor, twelve vanes, and two packings.

(5) Inspect vanes for damage. The vanes are not normally affected by wear, since wear is compensated for by centrifugal force. Inspect for scoring, gouging, and warping. If any vane is defective, replace all vanes in the rotor, using the vane kit.

(6) Replace the shaft seal (31) and all packings. These parts are available in a seal kit and are also available separately.



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1	Outlet cover
2	Cartridge
3	Inlet body
4	Cartridge
5	Outlet body
6	Spring
7	Pressure plate
8	Bushing
9	Pressure plate
10	Spring

Figure 8-3. Main and steering pump, cross section view.

f. Reassembly. Reassemble the main and steering pump in reverse of the numerical sequence as illustrated in figure 8-5.

(1) Apply a light film of clean hydraulic fluid to all parts for ease of reassembly and to provide initial lubrication.

(2) Torque the four screws (6) to 67-75 ft-lb.

g. Installation. Install main and steering pump (para 2-48).

8-6. Four-way Hydraulic Directional Control Valve Assembly

a. The four-way hydraulic directional control valve (fig. 8-6) consists of four separate sections and two different end covers. Each section has a manually operated spool for two-way control of the following components:

(1) Two boom hoist cylinders.

(2) Two boom guide cylinders.

(3) One follow-up scraper cylinder.

(4) Conveyor shift motor.

b. Testing. Test a valve suspected of being defective by connecting a 2500 psi pressure gage across each "A" and "B" port in turn. Check for pressure drops which indicate clogged orifices. Stall all cylinders and conveyor shift motor to test relief pressures (para 1-4). Test main relief valve by removing plug in inlet elbow and inserting pressure gage.

Note. Cracking pressure is 2000 psi. After testing, remove gage and install plug in elbow.

c. Removal. Remove the four-way hydraulic directional control valve assembly (para 2-48).

(1) Inspect housings for leaks before cleaning. Mark damp areas.

(2) Mark the sections numerically, one to four, before disassembly to identify for reassembly.

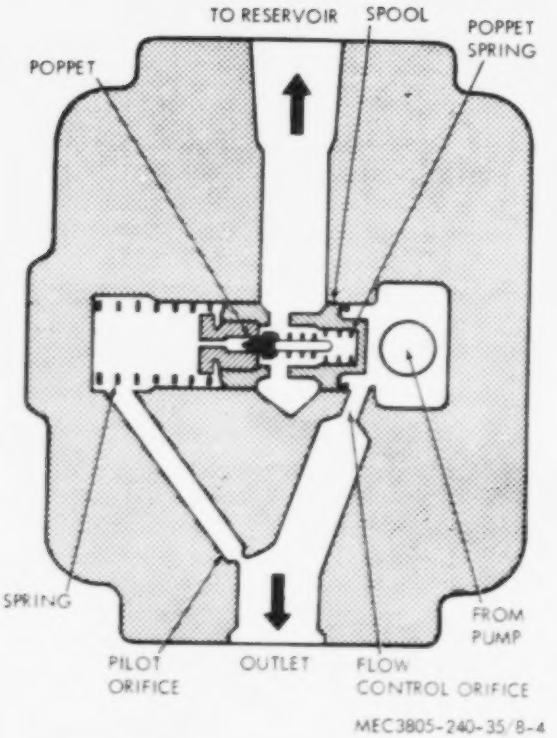


Figure 8-4. Main and steering pump, flow control.

d. Disassembly. Disassemble the four-way hydraulic directional control valve assembly in numerical sequence as illustrated on figure 8-7.

Note. Housings and spools are not available separately; spools are hone-fitted to individual housings.

(1) Separate the center section assemblies.

Note. For the purpose of these instructions, consider the section containing the main relief valve as the left side of the valve.

(*a*) Mount valve assembly vertically in a soft jawed vise.

(*b*) Remove assembly stud nuts (3, fig. 8-7) from right cover (5).

(*c*) Remove valve sections by sliding along stud assemblies (4).

(*d*) Remove three studs (4) from left end cover (7).

(2) Disassemble left end cover assembly (7).

(*a*) Remove preformed packing (8) and discard.

(*b*) Disassemble main relief valve assembly (9 through 19) and discard all packing.

Note. Record the number of shims (12) for later reassembly.

(3) Disassemble center section 1.

Note. For the purpose of these instructions, consider the control handle side of the valve the FRONT, and opposite side the BACK.

(*a*) At back of valve, remove bonnet and spring assembly (20 through 27). Discard all packing.

(*b*) Push spool (30) into housing (47) from front of valve until front packing (28) is exposed. Remove packing (8) and discard. Pull spool (30) out of housing (47) from front end.

***Caution:* Be very careful not to scratch or otherwise damage spool or housing bore.**

(*c*) Remove rear packing (29) and discard.

(4) Disassemble the port relief valve assemblies (31 through 46) and discard all packing.

(5) Disassemble center section 2. Refer to center section 1 procedures for disassembly instructions.

(6) Disassemble center section 3. Refer to center section 1 procedures for disassembly instructions.

(*a*) Disassemble anti-cavitation check valve assembly (87 through 96) installed in port A and discard packing.

(*b*) Disassemble port relief valve assembly (97 through 110) installed in port B and discard packing.

Note. Record the number of shims (100) for later reassembly.

(7) Disassemble center section 4. Refer to center section 1 procedures for disassembly instructions. Disassemble port relief valve assemblies (125 through 152) installed in ports A and B. Discard packing.

Note. Record the number of shims (128 and 142) for later reassembly.

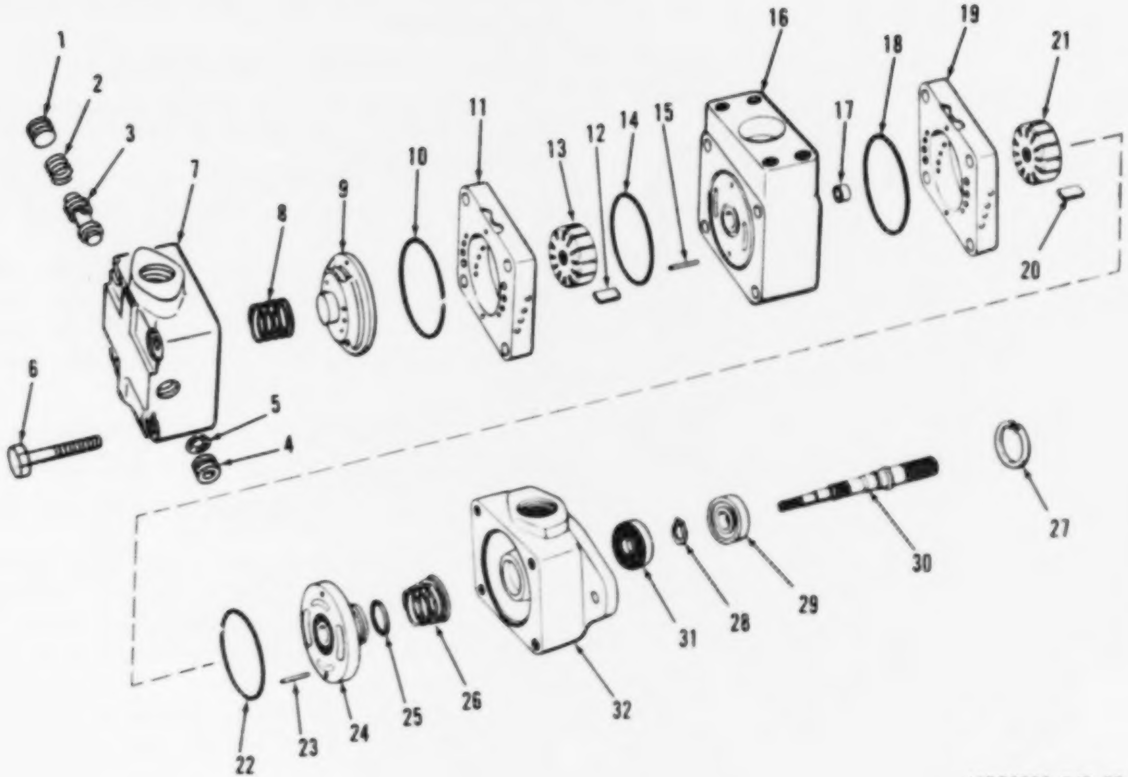
e. Cleaning. Clean all parts with an approved cleaning solvent and air dry.

(1) Thoroughly clean packing counterbores and ground surfaces of each section housing with an approved cleaning solvent and air dry.

(2) Thoroughly clean packing grooves on the spools with an approved cleaning solvent and air dry.

f. Inspection and Repair.

(1) Inspect spools and housings for wear, scoring, scratches, and gouges. If defective, replace as matched sets only.



MEC 3805-240-35/8-5

1	Plug
2	Spring
3	Valve control
4	Plug
5	Ring, retaining
6	Screw (4 rqr)
7	Cover, flow control
8	Spring
9	Plate, pressure
10	Packing, preformed
11	Ring
12	Vane (12 rqr)
13	Rotor
14	Packing, preformed
15	Pin (2 rqr)
16	Body, inlet
17	Bushing
18	Packing, preformed
19	Ring
20	Vane (12 rqr)
21	Rotor
22	Packing, preformed
23	Pin (2 rqr)
24	Plate, pressure
25	Packing, preformed
26	Spring
27	Ring, retaining
28	Ring, retaining
29	Bearing
30	Shaft
31	Seal, shaft
32	Body, outlet

Figure 8-5. Main and steering hydraulic pump, exploded view.

(2) Replace all packing. Soak new packing overnight in hydraulic system oil before assembly.

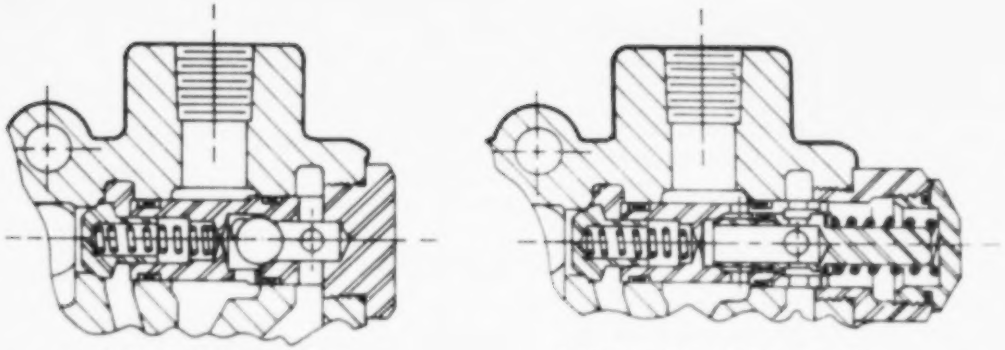
(3) Inspect all springs for cracks, breaks and sharp edges. Use a spring tester to check for weakness. Replace weak or otherwise defective springs. If test run was made before disassembly, a drop in relief valve pressure could indicate weak springs. Add or remove shims at relief valve springs if necessary. Shims are used to adjust cracking pressures. If preliminary test run indicated wrong cracking pressures, set main relief valve to crack at 2000 psi at 15 GPM by adding (pressure increase) or removing (pressure decrease) shims. Set relief valve in section III to crack at 2000 psi at 8 GPM by adding or removing shims. Set relief valves in section 4 to crack at 1250 psi at 4 GPM by adding or removing shims.

(4) Inspect all threads, threaded parts, and orifices. Retap threaded holes if possible. Replace parts if threads are defective beyond repair.

(5) Inspect steel ball (91) in check valve for wear and out-of-roundness and replace if defective.

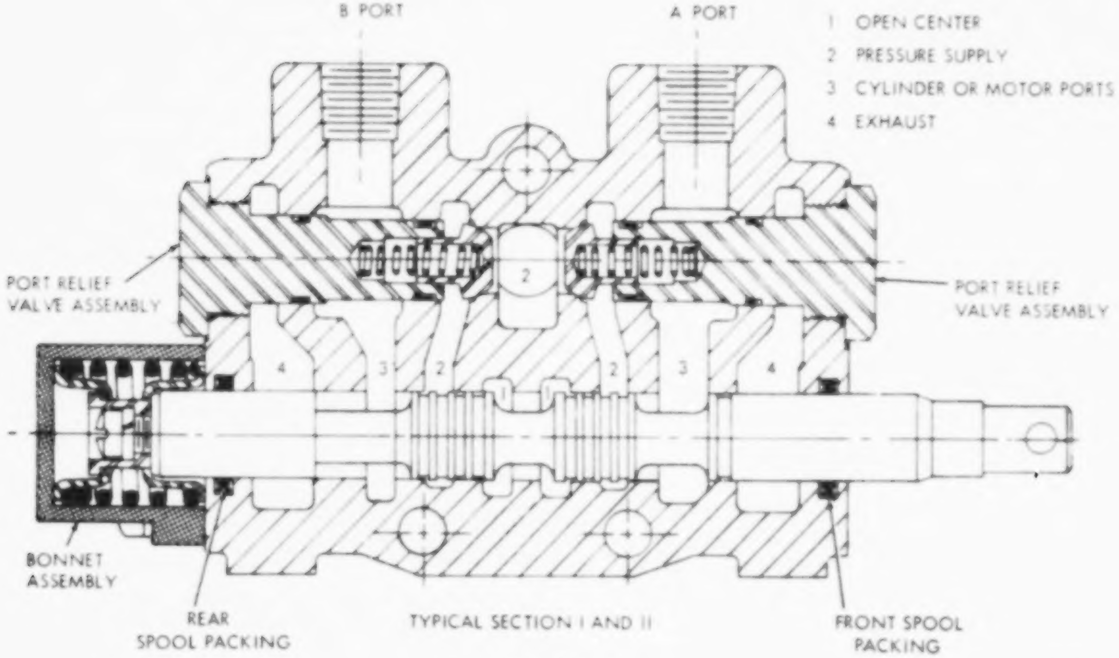
(6) Inspect all bonnets for dents and cracks. Replace if defective.

g. Reassembly. Reassemble four-way hydraulic directional control valve assembly in reverse of numerical sequence as illustrated on figure 8-7.

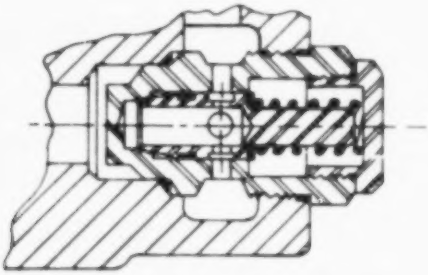


ANTI-CAVITATION CHECK VALVE SECTION III A PORT

RELIEF VALVE - SECTION III, B PORT
RELIEF VALVE - SECTION IV, A AND B PORTS


B PORT
A PORT
1 OPEN CENTER
2 PRESSURE SUPPLY
3 CYLINDER OR MOTOR PORTS
4 EXHAUST
PORT RELIEF VALVE ASSEMBLY
PORT RELIEF VALVE ASSEMBLY
2
4
3
2
2
3
4
BONNET ASSEMBLY
REAR SPOOL PACKING
FRONT SPOOL PACKING

TYPICAL SECTION I AND II



MAIN SYSTEM RELIEF VALVE, BOOM HOIST END COVER PLATE

MEC3805-240-35/8-6

Figure 8-6. Four-way hydraulic directional control valve, cross section.

Figure 8-7. Four-way hydraulic control valve, exploded view.

(Located in back of manual)

Note. All parts should be dipped in hydraulic oil to facilitate reassembly.

Caution: **Use extra care when installing packing and inserting parts to prevent scratching or other damage that could cause leaks.**

(1) Reassemble and install relief valve assemblies (125 through 152, fig. 8-7) in section 4.

(*a*) Install new packings. Use light grease on packings to prevent tearing while assembling and installing.

(*b*) Install same number of shims previously installed, unless cracking pressure was incorrect. If cracking pressure must be changed, add or remove shims to raise or lower cracking pressure.

(2) Install spool (123) through the front of housing (153), being sure screw hole end enters first.

(*a*) Push spool into housing to expose front packing groove. Insert new packing in front groove. Pinch one side of packing to bend into a shape slightly smaller than groove in housing. After packing has been properly placed in groove, straighten packing by running a smooth rod around exposed surface until a perfect fit is obtained. Check by running finger around exposed edge. Make sure there is a smooth, perfect ridge, with no kinks or twists.

(*b*) Apply a small amount of grease or heavy oil to packing to prevent tearing during reassembly.

(*c*) Pull spool toward front of housing until spool link end is exposed. Insert a metal rod three to four inches long and 1/4 inch diameter through handle pin hole for use as handle. Pull spool slowly past packing with a twisting motion until back packing groove is exposed.

Caution: **Do not pull spool too far or front packing will seat in spool groove and become damaged when spool is pushed back.**

(*d*) Install rear packing in same manner as front packing.

(*e*) Push spool into housing post near rear packing with a twisting motion until 5/16 inch of polished surface of spool remains exposed at front of housing.

(3) Reassemble and install bonnet assembly (20 through 27).

Note. Use 12 ft-lb of torque to tighten spool assembly screw (116).

(4) Reassemble and install relief valve assembly (97 through 110) in port B, section 3 housing, using the same procedures described for section 4.

(5) Reassemble and install anti-cavitation valve assembly in port A, section 3. Install new packing.

(6) Install spool and packing in section 3 housing, using same procedures used for section 4.

(7) Install the port relief valve assemblies in ports A and B of section 2 housing, using care not to damage new packing.

(8) Install spool and packing in section 2 housing, using same procedures used for section 4.

(9) Install bonnet assembly in section 2 housing. Use care to prevent damage to packing.

(10) Install port relief valve assemblies in ports A and B of section I housing, using care not to damage new packing.

(11) Install spool and packing in section I housing using same procedures used for section 4.

(12) Install bonnet assembly in section I housing, using care to prevent damage to packing.

(13) Reassemble and install main relief valve assembly in left end plate cover. If necessary, add or remove shims to obtain proper cracking pressure. Use care to prevent damage to packing.

(14) Reassemble left end plate cover, sections 1, 2, 3, 4, and right end plate cover.

(*a*) Place left end plate cover in soft metal vise. Insert three studs and stud assembly nuts. Slide sections 1, 2, 3, 4 and right end plate assembly over studs.

(*b*) Install stud assembly nuts and tighten nuts on both ends evenly to 20 ft-lb torque. More or less torque can cause spools to bind or stick.

Note. Use care in replacing sections so that packing counterbores are facing the right end of the valve.

h. Installation. Install the four-way hydraulic directional control valve (para 2-48) and inspect for hose connection leaks. Test-run to check operation of valve assembly. If valve relief settings are incorrect, disassemble valve and add or remove shims where necessary.

8-7. Boom Guide Hydraulic Cylinder Assembly

a. General. The two boom guide hydraulic cylinder assemblies are double-acting cylinders. The cylinder ends are pivoted at the ditcher frame. The cylinder rod ends are attached to the boom guide assembly. Hydraulic fluid under pressure to operate the cylinder assemblies is provided by the main and steering hydrualic pump. The up and down movements of the cylinder rods are manually controlled by the operator through one section of the four-way hydraulic control valve. When the cylinder rods are extended, the boom guide is in digging position. When the cylinder rods are retracted, the boom guide is in travel position and should be pinned and locked.

b. Removal. Remove the boom guide hydraulic cylinder assemblies (para 2–48).

***Warning:* The boom guide must be in travel position and locked before the cylinders are removed.**

***Caution:* Use a hoist of suitable capacity and a rope sling to remove the cylinders. Refer to paragraph 2–48. Avoid crushing integral tube.**

c. Disassembly. Disassemble the boom guide hydraulic cylinder illustrated on figure 8–8.

Note. Before disassembly, clean cylinder with approved cleaning solvent. Note any wet areas or leaks.

(1) Place cylinder in a soft-jawed metal vise vertically, with cylinder case eye down. Secure cylinder case eye.

***Caution:* Do not crush integral tube.**

(2) Fasten a rope hoist of suitable capacity to rod end eye. Slowly apply lift to rod eye while loosening head retainer (1) with a three-inch spanner wrench.

(3) Remove cylinder rod assembly and head retainer (1) as a complete assembly.

***Caution:* A great deal of force will be required to remove the cylinder rod assembly. Do not let end of rod drop. Place on a clean work bench.**

(4) Remove lock nut (3). Remove piston and piston follower assemblies. Remove packing and discard.

(5) Remove cylinder rod (12) from cylinder head (13) and retainer (1). Remove packing and discard.

d. Cleaning. Clean all parts with an approved cleaning solvent and air dry.

e. Inspection and Repair.

(1) Inspect lub fittings (19, 21) for free flow of lubricant or for crossed threads. Replace lub fittings if defective.

(2) Inspect bushings (20, 22) for wear or scoring. Press from eye of case (2) or rod (12) only if worn or defective. Replace if defective.

(3) Inspect piston (4) and follower (7) for wear or sharp edges. Replace if defective.

(4) Inspect cylinder head (13) and retainer (1) for wear or sharp edges. Replace if defective.

(5) Inspect cylinder case (2) for wear, cracks, or dents. Inspect ports for fluid and damaged threads. Replace cylinder case if defective.

(6) Inspect cylinder rod for straightness, gouges, cracks, and sharp edges. Replace if defective.

(7) Discard all packing and replace with new. Soak new packing overnight in clean hydraulic fluid before reassembly.

(8) After reassembly, if a test pump and pressure gauge of 2000 psi are available, test the cylinder assembly for leaks.

(*a*) Connect test pump hose to cylinder head end port.

(*b*) Pump fluid at 2000 psi into cylinder, hold pressure for 30 to 45 seconds and examine opposite port for leaks. Repeat test at rod end of cylinder, checking rod pistons (4, 10) and cylinder head (13) for leaks around packing.

f. Reassembly. Reassemble the boom guide hydraulic cylinders as illustrated on figure 8–8.

***Caution:* Before reassembly dip all parts in clean hydraulic fluid. Soak new packing overnight in clean hydraulic fluid.**

(1) Install new packing on pistons (4, 10), follower (7), and cylinder head (13). Be sure the "V's" of the chevron packings (5), (14) are facing the follower and each other.

(2) Install head retainer (1), cylinder head assembly, piston assemblies, and follower assembly on cylinder rod (12).

(3) Install lock nut (3) on cylinder rod and tighten to 250–270 ft-lb of torque.

(4) Place cylinder case (2) vertically in a soft metal vise with cylinder case eye down. Secure cylinder case eye.

(5) Lift cylinder rod and head retainer assembly with a hoist of suitable capacity and rope attached to rod end. Insert piston end of rod in cylinder case. Some force will be required. Use care to see that packing is not crimped or damaged.

(6) Insert cylinder head assembly in cylinder case, using care to prevent damage to packing.

(7) Tighten head retainer (1) with a three-inch spanner wrench.

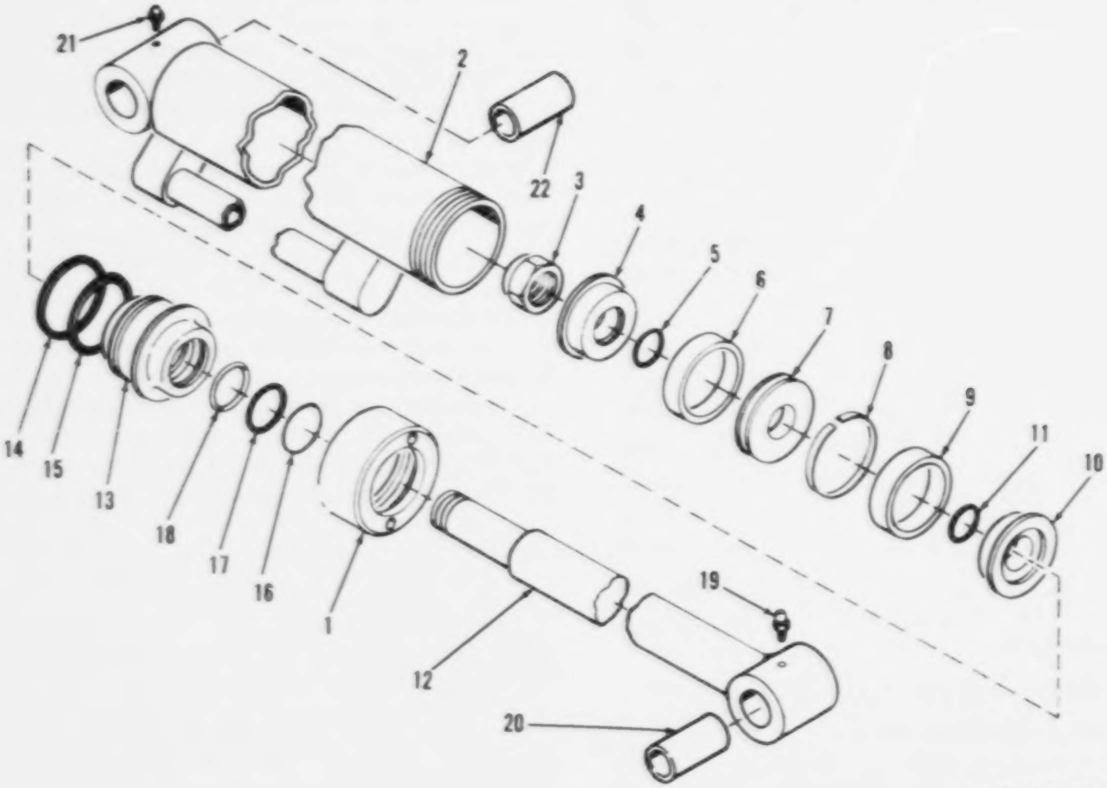
(8) Install lub fittings (19, 21).

(9) Test cylinder assembly for leaks.

g. Installation. Install the boom guide hydraulic cylinders (para 2–48).

8–8. Overcenter Valve Assembly (fig. 8–9)

a. General. The overcenter valve is used to control cylinder speed when the load tends to run ahead of the pump. It locks the load in any posi-



MEC3805-240-35/8-8

1	Retainer head	9	Packing, chevron	17	Bearing
2	Case	10	Piston	18	Packing, rod
3	Nut, lock	11	Packing, preformed	19	Fitting, grease
4	Piston	12	Rod, piston	20	Bushing
5	Packing, preformed	13	Head, cylinder	21	Fitting, grease
6	Packing, chevron	14	Packing, preformed	22	Bushing
7	Follower, piston	15	Ring, back-up		
8	Ring, wear	16	Wiper, rod		

Figure 8–8. Boom guide cylinder, exploded view.

tion without drift. An emergency manual release is provided on the valve. When pump flow is directed through the control valve oil passes through the checkvalve in the free flow direction. Since the relief valve is set at 2000 psi, positive pump pressure is always required to move the boom hoist cylinders. Oil returning from the cylinder is blocked by the check valve and must pass through the relief valve.

b. Testing. This valve assembly is non-serviceable. The cracking pressure can be tested and adjusted if a test pump and pressure gage of 2500 psi capacity are available.

(1) Attach test pump to cylinder port and block inlet port.

(2) Attach pressure gage to pilot port and adjust valve at overload relief adjustment and manual release.

(3) Replace valve assembly if defective.

c. Removal. Remove overcenter valve (para 2–48).

d. Cleaning. Clean overcenter valve with approved cleaning solvent and air dry.

e. Inspection and Repair. Inspect ports for crossed threads. Check body for leaks. Replace overcenter valve if defective.

f. Installation. Install overcenter valve (para 2–48). Test-run and inspect for leaks.

8–9. Boom Hoist Hydraulic Cylinder Assemblies

a. General. The two boom hoist hydraulic cylinder assemblies are mounted on the boom guide frame. The digging boom hoisting cables run over sheaves attached to the cylinder rods. Hy-

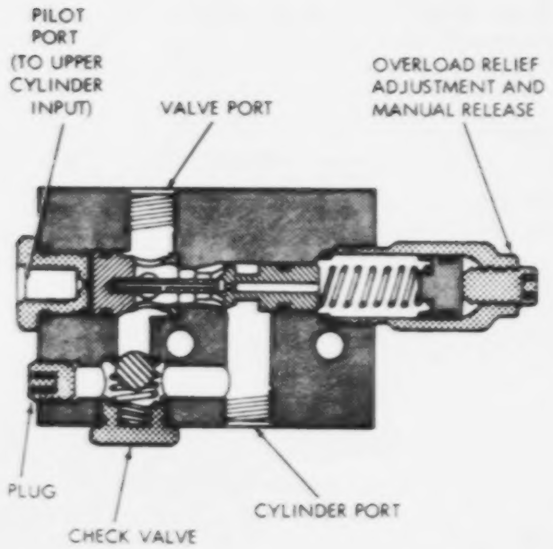

PILOT PORT (TO UPPER CYLINDER INPUT)
VALVE PORT
OVERLOAD RELIEF ADJUSTMENT AND MANUAL RELEASE
PLUG
CHECK VALVE
CYLINDER PORT
MEC3805-240-35/8-9

Figure 8–9. Overcenter valve assembly.

draulic fluid is supplied to the cylinders by the main and steering pump. The up and down movements of the cylinder rods are manually controlled by the operator through the four-way hydraulic control valve. When the cylinder rods are fully extended the boom and bucket line assemblies are in travel position and may be locked. When the cylinder rods are retracted the boom and bucket line assembly is in digging position.

b. Removal. Remove the boom hydraulic cylinder assemblies (para 2–48).

Warning: **The boom and bucket line assembly must be resting firmly on the ground or floor before removal of the cylinder assemblies. If a maintenance pit is available, place boom in full digging position.**

Caution: **Use a hoist of suitable capacity and a rope sling. Place cylinder in sling before starting removal to prevent damage.**

c. Disassembly. Disassemble the boom hoist hydraulic cylinder illustrated on figure 8–10.

(1) Place cylinder assembly in a soft jawed metal vise. Secure cylinder case eye.

Caution: **Do not crush external tube.**

(2) Attach a rope hoist of suitable capacity to cylinder rod eye.

(3) Slowly apply pressure on rod eye and loosen head retainer (1) with a 5.312-inch spanner wrench. Remove entire rod assembly and head retainer from cylinder case (2) as an assembly.

Caution: **Use care in this procedure. All parts are closely fitted. A great deal of force will be required. Do not permit end of assembly to drop on floor or bench.**

(4) Continue to disassemble in numerical sequence as illustrated on figure 8–10.

(5) Discard all packing and wear rings. Soak new packings overnight in clean hydraulic fluid before reassembly.

(6) Inspect bushings (19, 21) and press from eyes only if necessary.

d. Cleaning. Clean all parts with an approved cleaning solvent and air dry.

e. Inspection and Repair.

(1) Inspect lub fittings (18, 20) for free flow of lubricant and damaged threads. Replace fittings if defective.

(2) Inspect piston (4) and follower (7) for wear and sharp edges. Replace if defective.

(3) Inspect rod wiper (9) for wear and sharp edges. Replace if defective.

(4) Inspect cylinder head (13) for wear and sharp edges. Replace if defective.

(5) Inspect cylinder case for wear and cracks. Inspect ports for damaged threads and fluid restrictions. Replace cylinder case if defective.

(6) Inspect cylinder rod for straightness, cracks, or gouges. Replace if defective.

(7) Inspect bushings (19, 21) for wear and damage. Replace if defective.

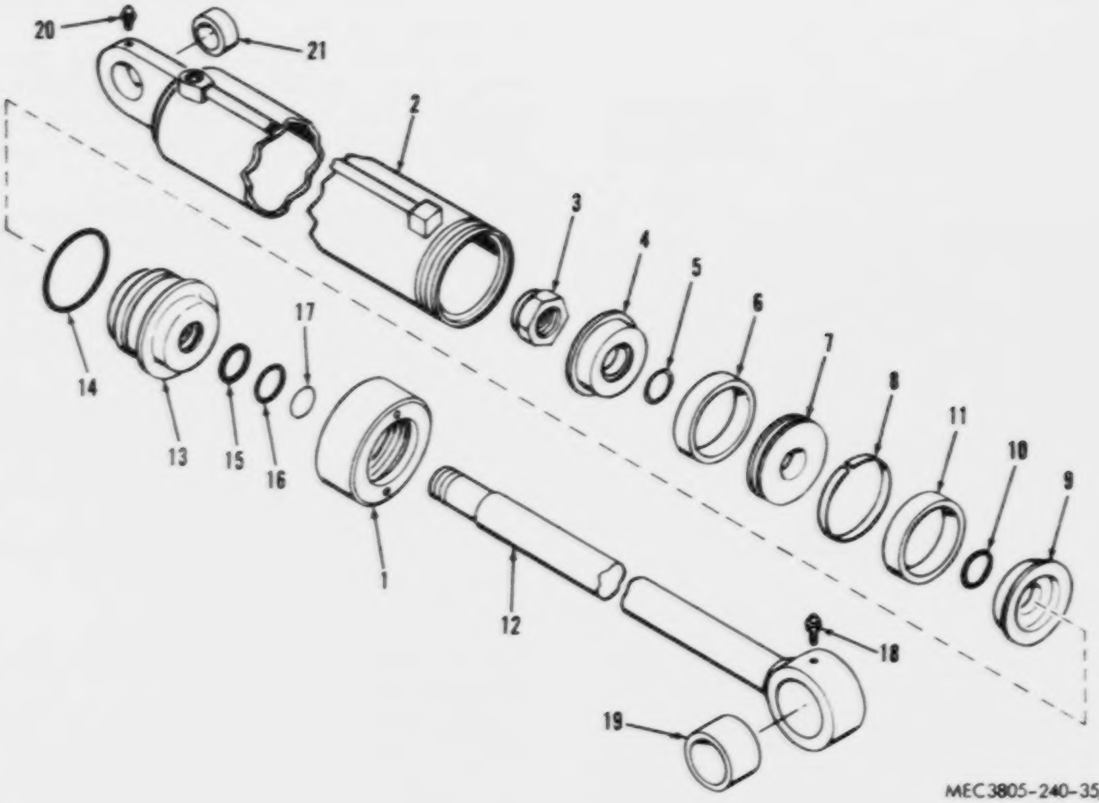
(8) After reassembly, if a test pump and pressure gage of 2000 psi capacity are available, test the cylinder assembly packings for leaks.

(*a*) Connect test pump hose to cylinder head and port.

(*b*) Pump fluid at 2000 psi into cylinder. Hold pressure for 30 to 45 seconds and examine opposite port for leaks. Repeat test at rod end port of cylinder, checking rod wiper and piston packing (5), (6), (10), (11), and (15) for leaks. If leakage is observed during time limit, disassemble cylinder assembly and replace all packing.

f. Reassemble. Reassemble boom hydraulic cylinder assembly illustrated on figure 8–10.

Caution: **Before reassembly, dip all parts in clean hydraulic fluid to prevent damage. Soak new packing overnight in clean hydraulic fluid.**



1	Retainer, head
2	Case
3	Nut, lock
4	Piston
5	Packing, preformed
6	Packing, chevron
7	Follower, piston
8	Ring, wear
9	Wiper, rod
10	Packing, preformed
11	Packing, chevron
12	Rod, piston
13	Head, cylinder
14	Seal
15	Packing, preformed
16	Bearing
17	Packing, rod
18	Fitting, grease
19	Bushing
20	Fitting, grease
21	Bushing

Figure 8-10. Boom hoist cylinder assembly, exploded view.

(1) Install new packing on piston follower (7) and cylinder head (13). Be sure "V's" of chevron packings (6 and 11) face toward follower (7) and each other.

(2) Install head retainer (1) on cylinder rod.

(3) Install cylinder head (13), piston (4), and follower (7) on cylinder rod (12).

(4) Install lock nut (3) and tighten to 1595 ft-lb of torque dry or 1090 ft-lb wet.

(5) Secure cylinder case eye and grip cylinder case with a soft-jawed vise. Mount case vertically if possible to facilitate installing cylinder end assembly. Secure cylinder rod eye with rope.

Caution: **Do not crush integral tube.**

(6) Lift cylinder rod assembly with a hoist of suitable capacity and carefully insert piston end of rod in cylinder case.

(7) Carefully guide cylinder head (13) into cylinder case.

(8) Tighten head retainer (1) with a 5.32-inch spanner wrench.

(9) Install lubrication fittings.

(10) Test cylinder assembly for leaks.

g. Installation. Install the boom hoist hydraulic cylinder assembly (para 2-48).

8-10. Follow-up Scraper Hydraulic Cylinder Assembly

a. General. The follow-up scraper-hydraulic cylinder assembly is mounted on the conveyor frame. The cylinder rod is fastened to the follow-up scraper. Hydraulic fluid under pressure is provided by the main and steering hydraulic pump to activate the cylinder rod. The up and down movement of the piston rod is controlled by the operator through one section of the four-way hydraulic control valve. When the cylinder rod is extended the follow-up scraper is in the down position. When the cylinder rod is retracted the follow-up scraper is in travel position.

b. Removal. Remove the follow-up scraper hydraulic cylinder assembly (para 2-48).

***Warning:* Before removing the cylinder assembly make sure the boom is resting firmly on the floor or ground.**

c. Disassembly. Disassemble the follow-up scraper hydraulic cylinder assembly illustration figure 8-11.

Note. Before disassembly, clean the outside of the cylinder assembly with an approved cleaning solvent. Be sure port holes are capped with plastic plugs.

(1) Support the cylinder assembly with the rod eye end up in a soft-jawed vise. Secure cylinder case eye.

(2) Attach rope hoist of suitable capacity to rod eye end. Using 3 7/8 inch, two-pronged spanner wrench, loosen and unscrew head retainer (1). At the same time, lift rod end component parts of cylinder assembly from cylinder case (2) as one assembly. Place on a clean work bench.

(3) Remove lock nut (3) from cylinder rod (9).

(4) Remove follower (4) and packing and disassemble. Discard packing.

(5) Remove chevron packing (6) and discard.

(6) Remove piston (7).

(7) Remove cylinder rod (9) from cylinder head (10) assembly. Remove gland nut (13) assembly and head retainer (1).

(8) Remove head retainer (1) from cylinder head (10).

(9) Remove cylinder head (10) assembly from gland nut (13) assembly and discard packing (11) and chevron packing (15).

(10) Remove preformed packing (14) from gland nut (13).

(11) Remove lubricant fittings (16) from rod eye and cylinder case eye.

(12) Inspect bushings and, if defective, press from rod eye and cylinder eye.

d. Cleaning. Clean all parts thoroughly with an approved cleaning solvent and air dry.

e. Inspection and Repair.

(1) Discard all preformed packing (8), 11, 14), wear ring (5), and other packing (6, 15). Replace with new packing and rings. Soak new packing and rings overnight in clean hydraulic fluid before reassembly.

(2) Inspect lubrication fittings (16, 18) for free flow of lubricant and for damaged threads. Replace fittings if defective.

(3) Inspect piston follower (4) and piston (7) for wear and sharp edges. Replace if defective.

(4) Inspect piston rod for straightness and wear. Replace if defective.

(5) Inspect retainer head (1) for wear, gouges, and damaged threads. Replace if defective.

(6) Inspect cylinder head for wear and sharp edges. Replace if defective.

(7) Inspect cylinder case (2) for wear, gouges, and dents. Inspect cylinder ports for damaged threads. Replace cylinder case if defective.

(8) Inspect bushings for wear and scoring. Replace if defective.

(9) After reassembly, if a test pump and pressure gage of 2500 psi capacity are available, test the cylinder assembly packing for leaks.

(*a*) Connect test pump hose to the cylinder head end port.

(*b*) Pump fluid of 2000 psi into the cylinder. Hold pressure for 30 to 45 seconds and examine opposite port for leaks. Repeat the test at rod end of cylinder, checking rod wiper packing (14) for leaks. If leakage is observed during the time limits disassemble the cylinder assembly and replace all packing.

f. Reassembly. Reassemble the follow-up scraper hydraulic cylinder assembly as illustrated on figure 8-11.

(1) If removed, press bushings (17, 19) in cylinder case eye and cylinder rod end eye.

(2) Install new preformed packing (14) in gland nut (13).

***Caution:* Before reassembly, dip all parts in clean hydraulic fluid to prevent damage. Soak new packing and rings overnight in clean hydraulic fluid.**

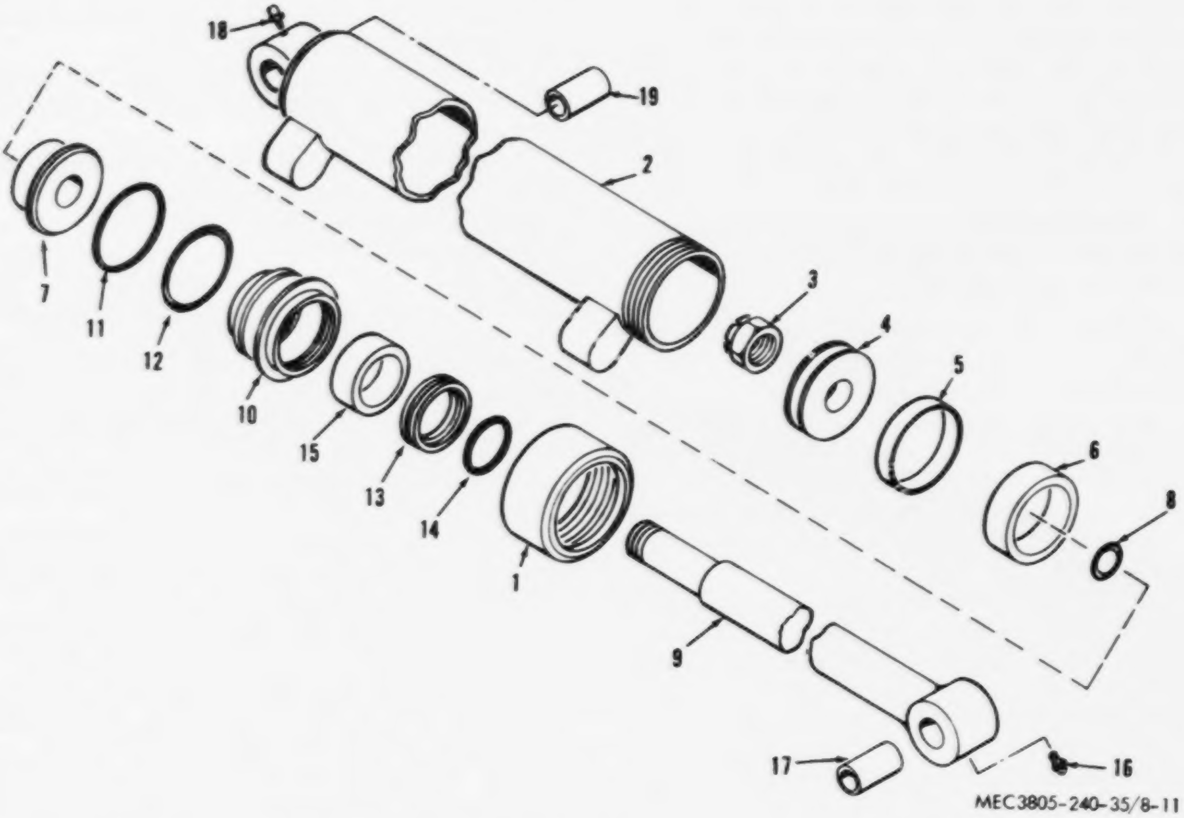
(3) Install new chevron packing (15) with "V" facing rod end back-up ring (12) and install new preformed packing (11) on cylinder head (10).

(4) Install gland nut (13) assembly in cylinder head (10) assembly.

(5) Install complete cylinder head and gland nut assembly in head retainer (1) and install on cylinder rod (9).

(6) Install new chevron packing (6) with "V" facing rod end on piston (7). Install new preformed packing (8).

(7) Install piston on cylinder rod (9).



1	Retainer, head
2	Case
3	Nut, lock
4	Follower, piston
5	Ring, wear
6	Packing, chevron
7	Piston
8	Packing, preformed
9	Rod, piston
10	Head cylinder
11	Packing preformed
12	Ring backup
13	Nut Gland
14	Packing preformed
15	Packing chevron
16	Fitting, grease
17	Bushing
18	Fitting, grease
19	Bushing

Figure 8–11. Follow-up scraper cylinder assembly, exploded view.

(8) Install new wear ring (5) on piston follower (4) and install follower assembly on cylinder rod (9).

(9) Install lock nut (3) on cylinder rod (9) and tighten to 84 ft-lb of torque.

(10) Lift entire cylinder rod assembly with hoist of suitable capacity, rope sling secured on rod, and lift directly over cylinder case (1).

Note. Place case in soft vise with eye down and secured.

(11) Carefully guide piston end of rod into cylinder case. Be sure rod wiper (14) and chevron packing are not crimped or torn. Slowly force rod into cylinder case.

(12) Guide rod into the cylinder case, being careful not to damage packing.

(13) Use 3 7/8-inch spanner wrench and tighten head retainer (1).

(14) Test cylinder assembly for leaks (para 8–10*e*, (9)).

g. Installation. Install the follow-up scraper hydraulic cylinder assembly (para 2–48).

8–11. Conveyor Shift Motor Assembly

a. General. The conveyor shift motor is an orbit motor used to shift the conveyor assembly to either the left or right side of the ditcher unit. The conveyor shift motor is controlled by one valve section of the four-way control valve. The motor is furnished with hydraulic fluid under pressure by the main and steering pump.

b. Removal. Remove conveyor shift motor (para 2–48).

c. Disassembly. Disassemble the conveyor shift motor in numerical sequence as illustrated on figure 8–12.

(1) Put motor in vise with jaws holding across port area. Do not clamp vise jaws on housing.

(2) Scribe a line on mounting plate (6) and housing (22) for alinement in reassembly.

Note. **Replace all seals and preformed packing.**

(3) Remove end cap. Observe position offset gear (13) with shaft keyway for reassembly purposes.

d. Cleaning. Clean all parts with an approved cleaning solvent and air dry.

e. Inspection and Repair.

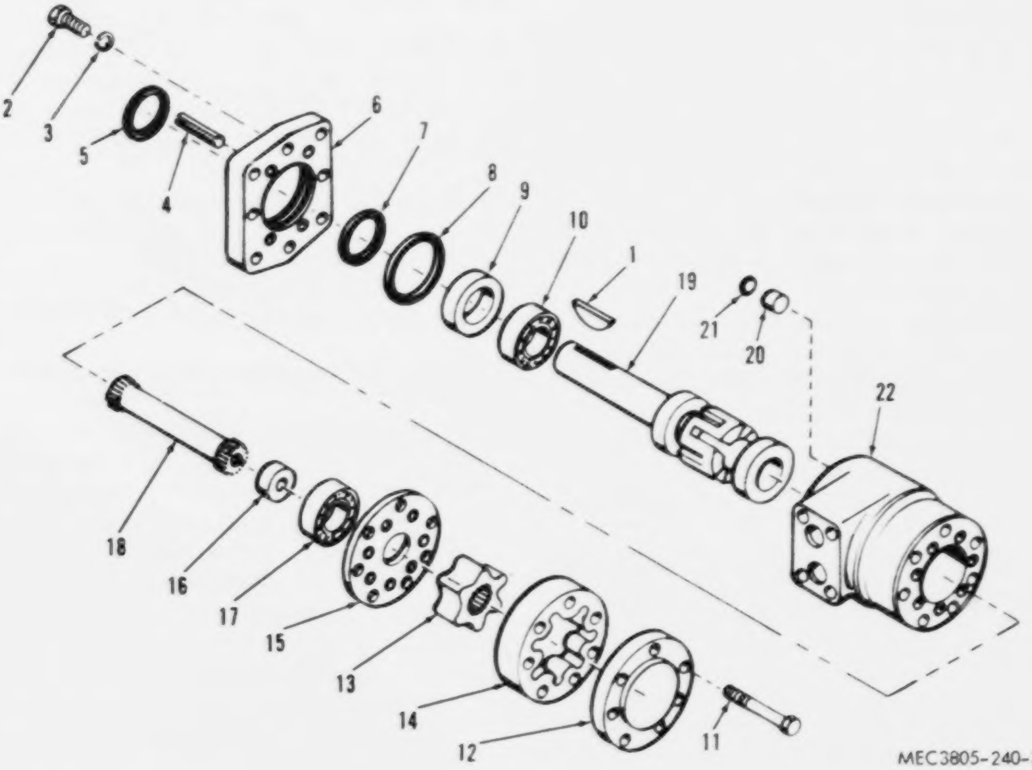
(1) Inspect all mating surfaces for scratches or burrs. Remove burrs with a hone.

(2) Inspect gear (13) and rotor (14) for wear. If necessary to replace either part, replace both as a unit.

(3) Inspect thrust bearings (10, 17) for wear and burrs. Replace defective bearings.

(4) Inspect mounting plate surfaces for scratches or burrs. Hone minor defects or replace mounting plate if necessary.

(5) Inspect output shaft (19) and drive shaft (18) for wear. Inspect splines for breaks and cracks. Replace defective parts.



MEC3805-240-35/8-12

1	Key	12	Cap, end
2	Screw, 5/16-18 x 3/8 in. (4 rqr)	**13	Gear, offset
3	Washer, lock, 5/16 in. (4 rqr)	**14	Rotor
4	Pin, roll (4 rqr)	15	Plate, spacer
*5	Seal, oil	16	Spacer
*6	Plate, mounting	17	Bearing, roller, thrust
7	Seal	*,**18	Shaft, drive
8	Packing, preformed	*19	Shaft, output
9	Race, bearing	*20	Plug, housing (2 rqr)
10	Bearing, roller, thrust	*21	Packing, preformed
11	Screw, 5/16-24 x 3 1/4 in. (7 rqr)	*,**22	Housing

*These items are removed as an assembly.
**These items are matched sets and cannot be obtained separately.

Figure 8-12. Conveyor shift motor, exploded view.

(6) Inspect housing (22) for sharp edges and burrs. All mating surfaces are machine-ground to prevent leakage. Do not pry with screw driver. If there is leakage at any of the mating surfaces, use the following honing method.

(*a*) Place piece of No. 600 grit paper on a surface that is plate glass smooth.

(*b*) Remove sharp edges of the grit by rubbing with a flat piece of scrap metal before use on motor.

(*c*) Place mating surface on paper and stroke gently in a figure-8 motion several times. Do not rub on abrasive unless absolutely necessary.

f. Reassembly. Reassemble conveyor shift motor in reverse of numerical sequence as illustrated on figure 8-12.

(1) Slide drive shaft (18) into motor housing (22) far enough to accommodate thrust bearing (17).

(2) With ports facing down, install output shaft (19) so that shaft keyway is 15° off center line of rotor tooth as illustrated on figure 8-13.

(3) Install thrust bearing (17, fig. 8-12) drive shaft (18), and spacer plate (15), so that holes are in alignment.

(4) Place gear (13) and rotor (14) on splined drive shaft (18), with chamfered side of gear and rotor assembly toward housing. Install gear and rotor assembly with gear tooth centerline straight up and shaft keyway 15° offset from tooth centerline as illustrated on figure 8-13.

(5) Install spacer (16, fig. 8-12) inside gear star.

(6) If holes do not line up, grasp gear and rotor assembly and twist into alinement. Do not permit assembly to disengage from splines on drive shaft or direction of motor rotation will change.

(7) Install end cap (12). Install capscrews and tighten alternately to 175-200 in-lb of torque.

(8) Reverse motor and install thrust bearing (10) and bearing race (9).

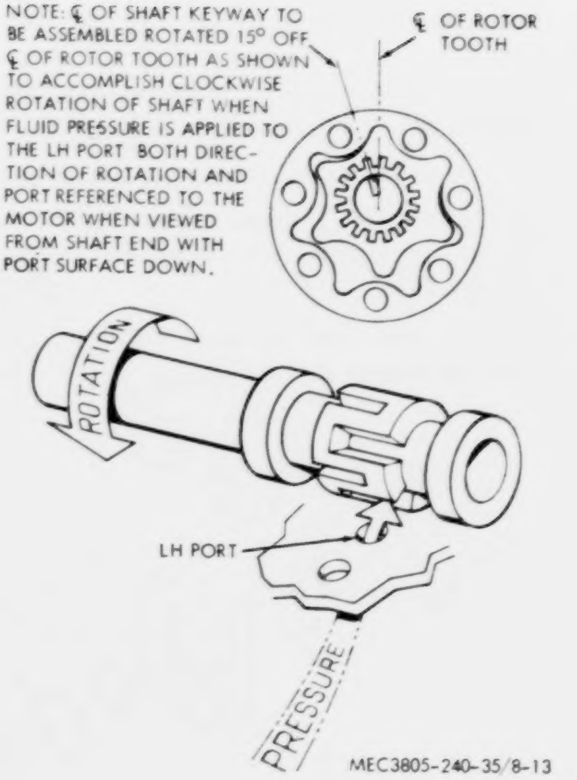

NOTE: ℄ OF SHAFT KEYWAY TO BE ASSEMBLED ROTATED 15° OFF ℄ OF ROTOR TOOTH AS SHOWN TO ACCOMPLISH CLOCKWISE ROTATION OF SHAFT WHEN FLUID PRESSURE IS APPLIED TO THE LH PORT BOTH DIRECTION OF ROTATION AND PORT REFERENCED TO THE MOTOR WHEN VIEWED FROM SHAFT END WITH PORT SURFACE DOWN.

Figure 8-13. Conveyor shift motor shaft key installation.

(9) Insert new seal (7) into its groove with lips facing out. Make sure lips are flush with mounting plate.

Note. **Before** installing seals and preformed packing, dip in hydraulic fluid. Install by leading in with finger. Use care to prevent damage to packing and seals.

(10) Install new seals (5, 7) and preformed packing (8).

(11) Install mounting plate (6).

(12) Install roll pins (4).

(13) Install and tighten capscrews to 225-275 in-lbs of torque.

g. Installation. Install conveyor shift motor (para 2-48).

Section III. CROWD DRIVE HYDRAULIC SYSTEM

8-12. General

The crowd drive hydraulic system contains a variable displacement crowd drive pump assembly, a double relief and replenishing valve, and a vane type crowd drive motor. Pump rotation is controlled by crowd drive pump start-stop valve, used to engage or disengage the clutch assembly of the power takeoff (para 4-20 through 4-26) mounted on the torque converter housing. It is furnished with fluid under pressure from the transmission assembly and is not a component part of the main hydraulic system. In operation, fluid recirculates through the subsystem; make up fluid, when required, is supplied from the main hydraulic tank through the double relief and replenishing valve assembly. The crowd drive pump supplies fluid under force to the crowd drive motor, mounted on the transfer case, which propels the ditcher when digging operations are in process.

8-13. Double Relief and Replenishing Valve

a. General. The double relief and replenishing valve assembly (fig. 8-14) contains two one-way check valves and two relief valves having cracking pressures of 2000 psi. Hydraulic fluid under pressure is routed by the crowd drive pump directly to the crowd drive motor. When pressure builds up in the system, the flow is stopped by the check valves and forced through the relief valves. Fluid flow is continuous and pressure remains nearly constant, so that the pump is replenished with fluid as needed.

b. Testing. If a test pump and pressure gage of 2500 psi is available, test the double relief and replenishing valve for leaks and 2000 psi cracking pressure before removing from the ditcher.

(1) Remove hose assemblies and cap with a plastic or rubber cap.

(2) Attach test pump to inlet port. Attach pressure gage on one of the outlet ports. Plug other port. Check cracking pressure. Check for leaks.

(3) Check other outlet port in same manner.

c. Removal. Remove the double relief and replenishing valve assembly (para 2-48).

d. Disassembly. The double relief and replenishing valve assembly is nonserviceable and must be replaced as an assembly if defective. Plugs and preformed packing illustrated on figure 8-14 can be replaced if defective.

e. Cleaning. Clean the valve assembly and plugs thoroughly with an approved cleaning solvent and air dry.

f. Inspection and Repair.

(1) Inspect plugs for wear and crossed threads. Replace if defective.

(2) Discard performed packing and soak new packing in oil overnight before reassembly.

(3) Inspect body for leaks and test run assembly. Replace assembly if defective.

g. Reassembly. Reassemble plugs and preformed packing in the valve body assembly as illustrated on figure 8-4.

(1) Use care to avoid damaging packing.

(2) Test run valve assembly for leaks and cracking pressure.

h. Installation. Install the double relief and replenishing valve (para 2-48).

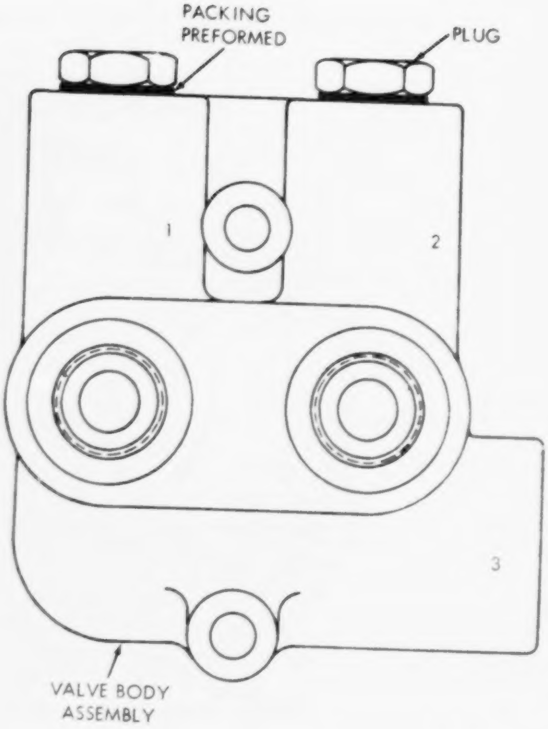


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Figure 8-14. Double relief and replenishing valve, cross section view.

8-14. Crowd Drive Pump Assembly

a. General. The crowd drive pump (fig. 8-15 and fig. 8-16) is a double-element unit combining a variable displacement axial piston pump with an auxiliary vane-type pump. Both pumps are driven from a common shaft at 2000 rpm. The piston pump section provides up to 32 GPM for operation of the crowd drive motor. The vane type pump section provides approximately two GPM for the pressure compensator control of the piston pump section. The pressure compensator control automatically adjusts pump delivery to maintain the volume requirements of the system at a preselected pressure. Maximum pump delivery is maintained to approximately 50 psi below the pressure control setting before being reduced. The pump has an adjustment range of 150 to 1500 psi.

b. Removal. Remove the crowd drive pump (para 2-48).

c. Disassembly. Disassemble the crowd drive pump assembly in numerical sequence as illustrated on figure 8-17.

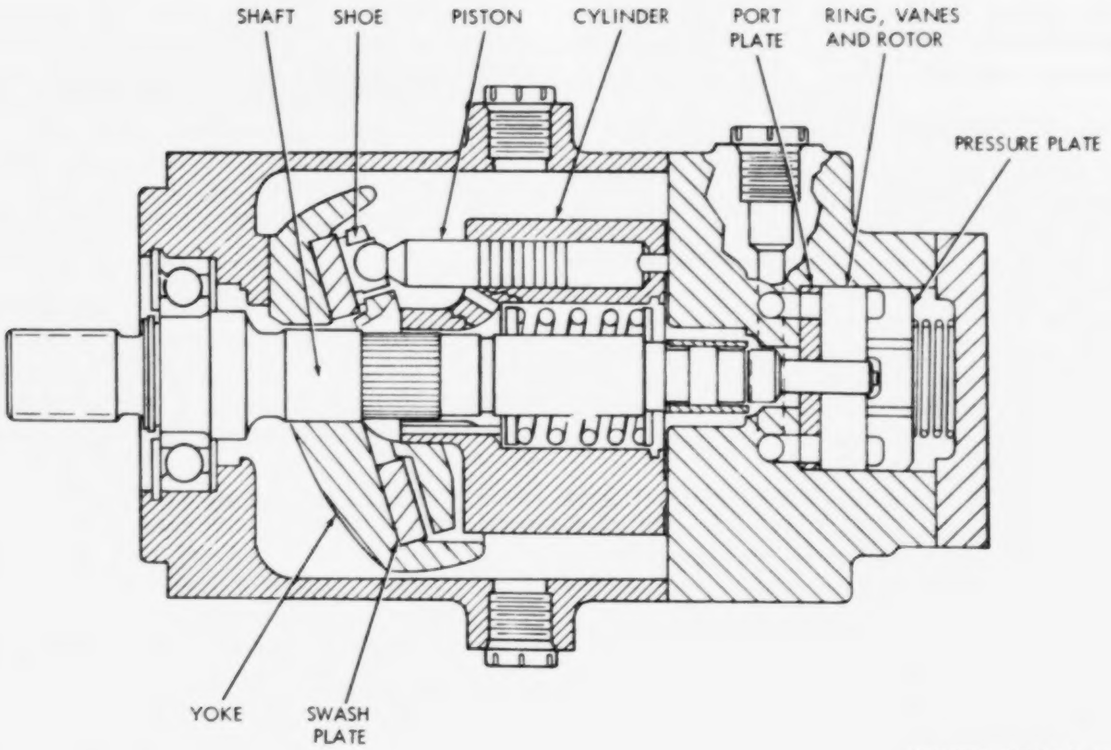


Figure 8-15. Crowd drive pump components.

(1) Remove auxiliary pump cover (4) and associated parts from valve plate (43).

(2) Remove end caps (20 and 26) and associated parts from valve plate and remove valve plate.

C.ution: In removing the rotating group (48 through 57), be sure that the piston and shoe assemblies (48) do not separate from the cylinder block (57).

(3) Turn rotating group assembly slightly to free it from the swash plate (64). Tilt housing (76) and remove rotating group assembly.

(4) Carefully lift each piston and shoe assembly from cylinder block. Keep pistons from striking one another or other hard objects.

Warning: Bodily injury can result from sudden release of the cylinder block spring (55).

(5) If the spring and washers are to be removed from the cylinder block, follow the procedure illustrated on figure 8-18.

Note. The outside diameter of the swash plate is smaller than the inside diameter of the recess in the yoke (70). A properly seated swash plate can be freely rotated with the fingertips. Removal may be slightly difficult due to oil suction under the swash plate.

(6) Rotate swash plate (64, fig. 8-17) and pull out evenly from yoke.

(7) Remove retaining ring (59). Tap end of drive shaft (61) with a soft-tip hammer to free shaft from bearing (60) and housing.

(8) Remove screws (65). Remove pintles (68) and plugs (66) by tapping from inside of housing.

d. Cleaning. Clean all parts thoroughly with an approved cleaning solvent prior to inspection and after any lapping or machining operation.

e. Inspection and Repair.

(1) Inspect valve plate (43, fig. 8-17) for wear and scoring. If wear or scoring is extensive, replace valve plate.

Note. Lapping of valve plate is not permissible.

(2) Inspect bores and valve plate mating surface of cylinder block (57) for wear and scoring. If wear or scoring is extensive, replace cylinder block.

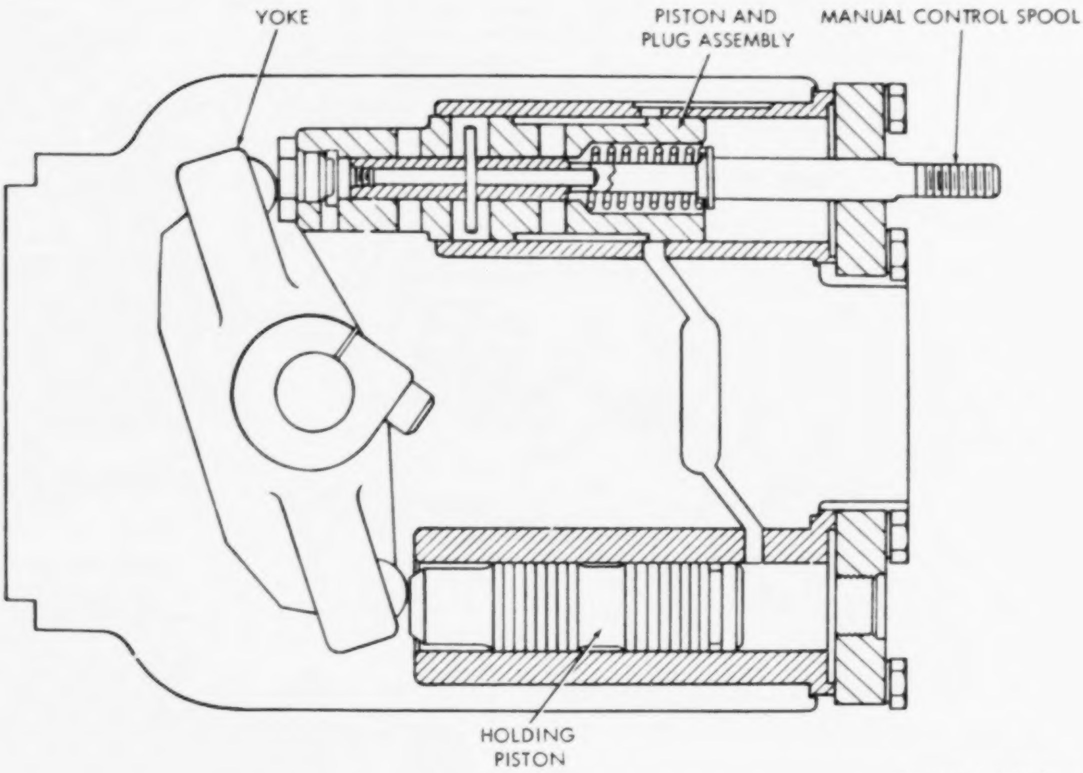


Figure 8-16. Crowd drive pump displacement control.

Note. The valve plate mating surface of the cylinder block can be refinished. If machining is required, not more than 0.010-inches should be removed prior to lapping.

(3) Inspect piston and shoe assemblies (48) for wear and damage. Check shoe face-to-back shoulder dimension of all nine assemblies.

Note. A variation greater than 0.001-inches in above measurements between shoes will result in excessive wear. If any piston and shoe assembly is defective, all nine assemblies must be replaced.

(4) Replace swash plate if there is any evidence of wear or scoring.

(5) Inspect all bearing for roughness and excessive end play and replace if necessary.

(6) Inspect seal journal of shaft (61) for wear and scoring and replace if necessary.

(7) Inspect ring (14), rotor (15), and vanes (16), for excessive wear and replace if necessary. These parts are available in a kit.

f. Reassembly. Reassemble the crowd drive pump assembly in reverse of numerical sequence illustrated on figure 8-17.

(1) Select a new gasket, oil seal, and packing.

(2) Apply a light film of clean hydraulic fluid to ease reassembly and to provide initial lubrication.

(3) Install yoke (70) by inserting pintles (68), alining pintle grooves, and securing pintles in place with two screws torqued to 90-100 ft-lb.

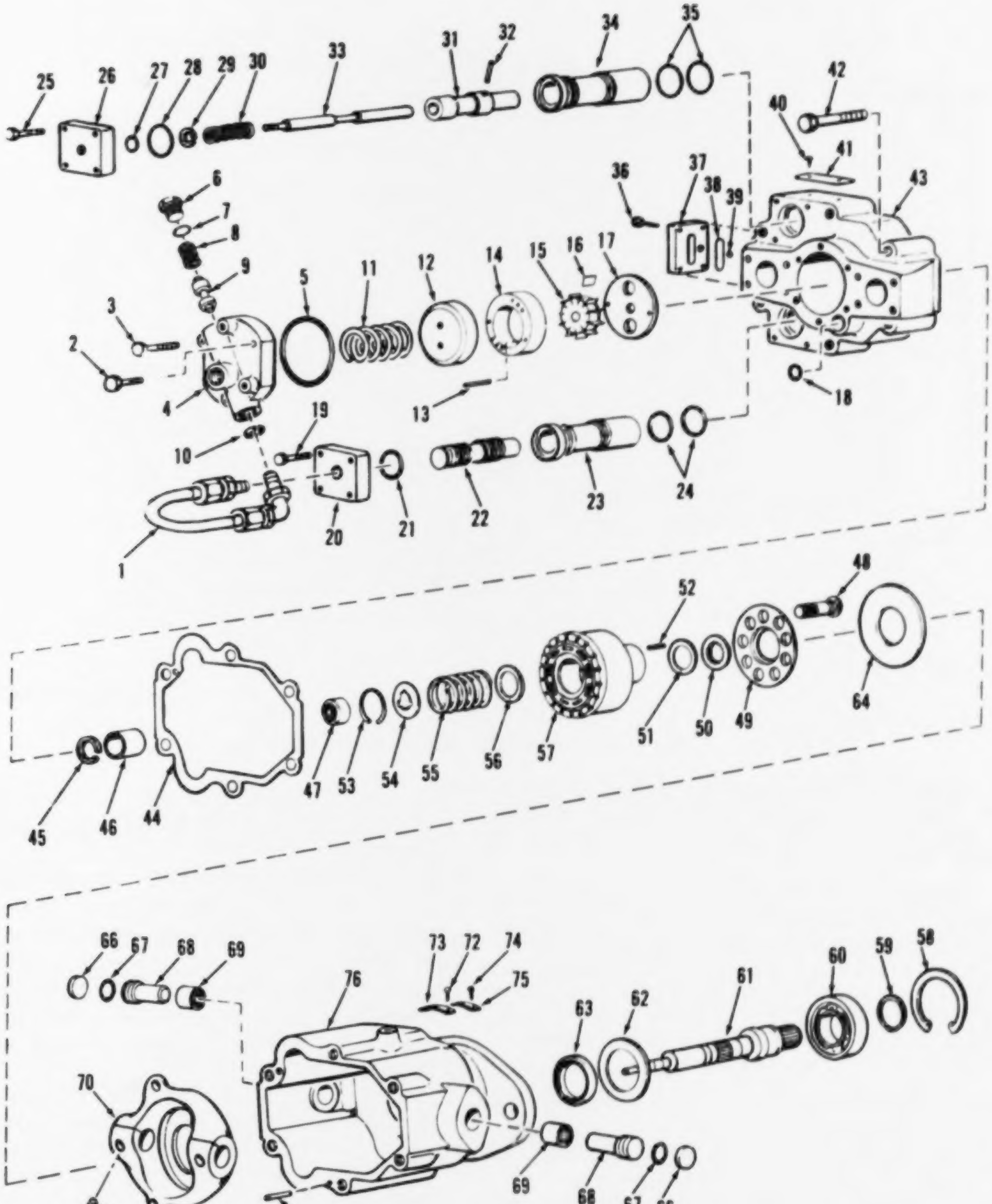
(4) Install packings (67) and plugs (66). Plugs must be pushed in with a force of approximately 350 pounds to provide a good seal at the packings.

(5) Install oil seal (63) in housing with spring toward yoke. Place retainer (62) over seal and then install drive shaft (61) in housing. Secure drive shaft bearing (60) with retaining rings (58) and (59).

(6) Install swash plate (64) in yoke. It is important that swash plate by properly seated and can be freely rtoated by using fingers.

(7) Assemble spring (55) and washers (54 and 56) in cylinder block (57) in reverse of sequence illustrated on figure 8-17.

(8) Place cylinder block face down on a smooth, clean surface. Insert three pins (52) into cylinder block. Grease the back-up washer (51)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1 Tube and fittings assembly
2 Screw (2 rqr)
3 Screw (4 rqr)
4 Cover, auxiliary pump
5 Packing, preformed
6 Plug
7 Packing, preformed
8 Spring
9 Relief valve assembly

Figure 8-17. Crowd drive pump assembly, exploded view.

10 Ring, retaining
11 Spring
12 Plate, pressure
13 Pin (2 rqr)
14 Ring
15 Rotor
16 Vane (10 rqr)
17 Plate, port
18 Packing, preformed
19 Screw (4 rqr)
20 Cap, end
21 Packing, preformed
22 Piston, holding
23 Cylinder, holding piston
24 Packing, preformed (2 rqr)
25 Screw (4 rqr)
26 Cap, end
27 Packing, preformed
29 Ring, retaining
30 Spring
31 Piston and plug assembly
32 Pin, roll
33 Spool, valve
34 Cylinder, stroking piston
35 Packing, preformed (2 rqr)
36 Screw (4 rqr)
37 Plate, manifold
38 Packing, preformed
39 Packing, preformed
40 Screw, self tapping (2 rqr)
41 Plate, identification
42 Screw (6 rqr)
43 Plate valve
44 Gasket
45 Ring, retaining
46 Race, inner
47 Bearing, needle
48 Piston and shoe assembly (9 rqr)
49 Plate, shoe
50 Washer, spherical
51 Washer, back-up
52 Pin, straight (3 rqr)
53 Ring, retaining
54 Washer, lift stop
55 Spring, compression
56 Washer, thrust
57 Cylinder
58 Ring, retaining
59 Ring, retaining
60 Bearing, ball
61 Shaft, drive
62 Retainer, oil seal washer
63 Seal, shaft
64 Plate, swash
66 Plug, pintle bore (2 rqr)
66 Plug, pintle bore (2 rqr)
67 Packing, preformed (2 rqr)
68 Pintle (2 rqr)
69 Bearing, needle (2 rqr)
70 Yoke and ball assembly
71 Pin, dowel (2 rqr)
72 Screw, self tapping (2 rqr)
73 Plate, rotation
74 Screw, self tapping (2 rqr)
75 Plate, instruction
76 Housing

Figure 8-17—Continued

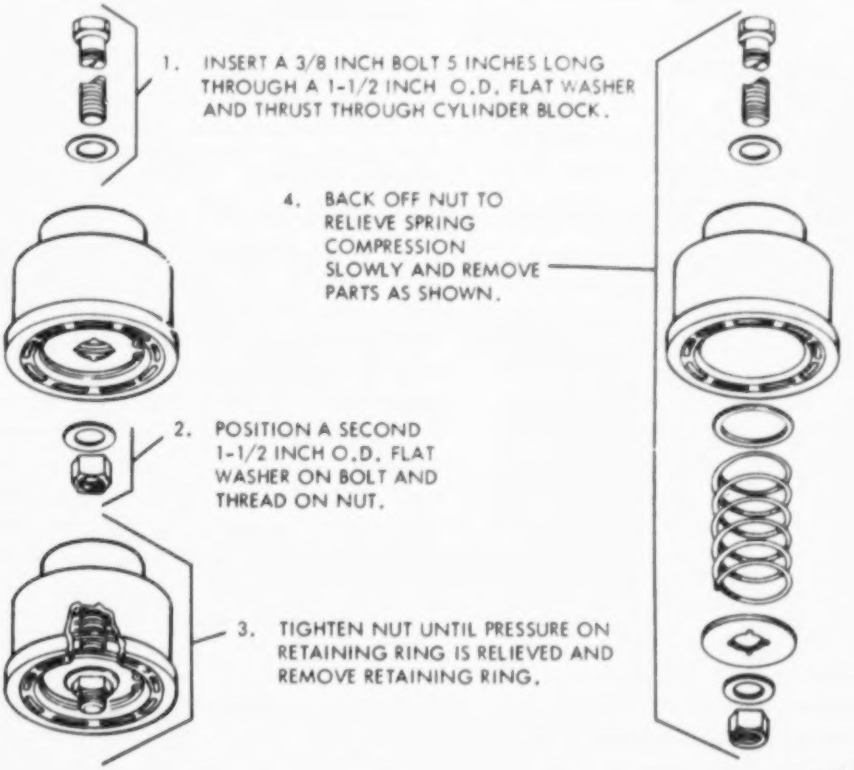
1. INSERT A 3/8 INCH BOLT 5 INCHES LONG THROUGH A 1-1/2 INCH O.D. FLAT WASHER AND THRUST THROUGH CYLINDER BLOCK.
4. BACK OFF NUT TO RELIEVE SPRING COMPRESSION SLOWLY AND REMOVE PARTS AS SHOWN.
2. POSITION A SECOND 1-1/2 INCH O.D. FLAT WASHER ON BOLT AND THREAD ON NUT.
3. TIGHTEN NUT UNTIL PRESSURE ON RETAINING RING IS RELIEVED AND REMOVE RETAINING RING.

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Figure 8-18. Crowd drive pump cylinder block, disassembly.

and spherical washer (50) and place them on the pins.

***Caution:* Be sure that the piston and shoe assemblies (48) do not strike one another or any hard object.**

(9) Put nine piston and shoe assemblies in shoe plate (49). Carefully holding shoe plate so that pistons do not strike one another, aline pistons with bores and maneuver them into place. Each piston must move freely in a lubricated block bore.

(10) Apply pressure to cylinder block and shoe plate to keep pins, washer, and spherical washer intact and install rotating group on drive shaft.

Note. Slight rotation during assembly will help aline the spherical washer and cylinder block splines with those of the drive shaft.

(11) Install needle bearings (47) and inner race (46) on end of drive shaft and add retaining ring (45). Mount valve plate (43) and associated parts. Torque screws (42) to 90–100 ft-lb.

(12) Mount remaining parts in valve plate. Torque auxiliary pump cover screws (2 and 3) and end cap screws (19 and 25) to 15–25 ft-lb.

g. Installation. Install crowd drive pump (para 2–48).

8–15. Crowd Drive Motor Assembly

a. General. The crowd drive motor (fig. 8–19) is a single-element vane-type unit which is operated by the crowd drive pump during the ditching operation. The motor drives a series of gears in the transfer case, thus moving the ditcher forward at low speed. The vanes operate within slots in the rotor to form ten chambers with their boundaries being the vanes, the rings, the rotor, and the pressure plates. The springs force the vanes to follow the elliptical inner surface of the ring. High pressure fluid enters chamber through inlet ports in the ring. The pressure of the fluid causes the chamber to increase in volume by rotating within the ring. This action rotates the shaft. As the chamber passes the outlet ports in the ring, the chamber decreases in size to expel the fluid. Two sets of outlet ports and two sets of inlet ports are used on the ring to balance out radial loads on the shaft.

b. Removal. Remove the crowd drive motor (para 2–48).

c. Disassembly. Disassemble the crowd drive motor in the numerical sequence illustrated on figure 8–20.

Caution: **When the rotor (12) and ring (14) are separated, the spring loaded vanes will fly out. To avoid damage to, or loss of, the vanes and springs, restrain and release these carefully during disassembly.**

d. Cleaning. Clean all parts thoroughly with an approved cleaning solvent prior to inspection and after any lapping or grinding operation.

e. Inspection and Repair.

(1) Inspect pressure plates (8 and 16, fig. 8–20) for excessive wear and scoring and replace if necessary.

Note. A new pressure plate subassembly includes the plate (8), bushing (9), and two pins (4).

(2) Check ring (14) and rotor (12) for wear and scoring. Lapping or light grinding of these parts is permissible. If excessively worn or scored, replace.

(3) Check vanes (10) for excessive wear or damage. Check springs for uniformity of length and tension.

Note. If any of these parts are defective, replace all of the parts using the vane kit, which contains 10 vanes and 30 springs.

(4) If rotor or ring are defective, repair using cartridge kit, which includes items 3 through 18 and parts 20 and 21.

Note. If a new cartridge kit is not used, replace all preformed packing, backup rings, the shaft seal and felt wiper. These parts are contained in a seal kit. If a new cartridge kit is used, replace the shaft seal and felt wiper separately. The preformed packing and backup rings are included in the cartridge kit.

f. Reassembly.

(1) Apply a light coat of grease to inner surface of shaft seal (27, fig. 8–20). Saturate felt wiper (28) in oil.

(2) Apply a light film of clean hydraulic fluid to all remaining parts to ease reassembly and to provide initial lubrication.

(3) Reassemble crowd drive motor in a reverse of numerical sequence illustrated on figure 8–20. Be sure that spring-loaded side of shaft seal faces bearing (24). Torque two pressure plate screws (7) to 2–4 ft-lb. Torque four bolt (1) to 95–105 ft-lb.

g. Installation. Install the crowd drive motor (para 2–48).

8–16. Crowd Drive Pump Start-Stop Valve

a. General. The crowd drive pump start-stop valve is a two-way hydraulic selector used to engage and disengage the clutch of the power take-off assembly located on the torque converter. Engaging the clutch operates the crowd drive pump. This valve does not share fluid with the rest of the hydraulic system; it operates on transmission fluid.

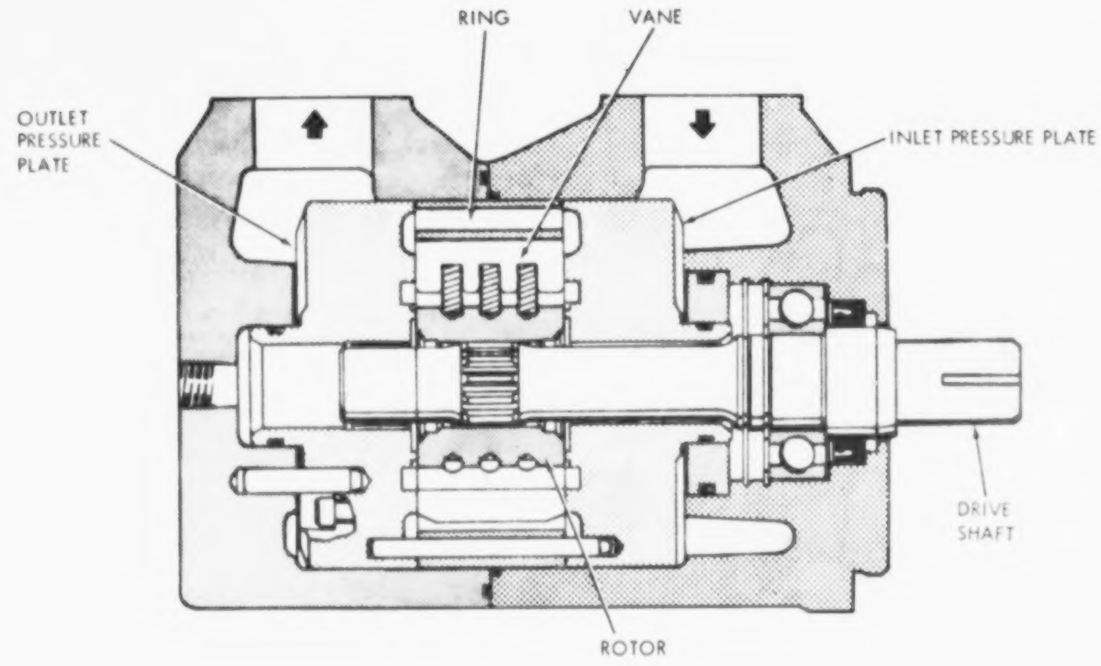

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Figure 8-19. Crowd drive motor assembly, cross section.

b. Removal. Remove the crowd drive pump start-stop valve (para 2-48).

Note. Use plastic or rubber caps to plug ports and piping.

c. Disassembly. Disassemble the crowd drive pump start-stop valve in the numerical sequence as illustrated on figure 8-21.

***Caution:* When cleaning body of valve before disassembly be careful not to let dirt or other contaminants enter valve. Use a clean work bench for disassembly.**

(1) Remove retaining ring (1, 2) at handle end and rear end of spool.

(2) Push control knob (4) in until rear seal (3) is exposed. Remove rear seal.

(3) Remove knob (4) and spool (6) as an assembly.

(4) Remove knob (4), lockwasher (5) and knob end seal (7) from spool (6).

(5) Discard seals.

c. Cleaning. Clean all parts in approved cleaning solvent and air dry.

d. Inspection and Repair.

(1) Inspect spool and housing for wear, gouges, and scoring. If defective, replace entire valve assembly.

(2) Soak new seals overnight in clean, light transmission oil.

(3) After reassembly, if a test pump and pressure gage of 2000 psi are available, test valve and seals for leaks.

(*a*) Connect test pump to upper center port.

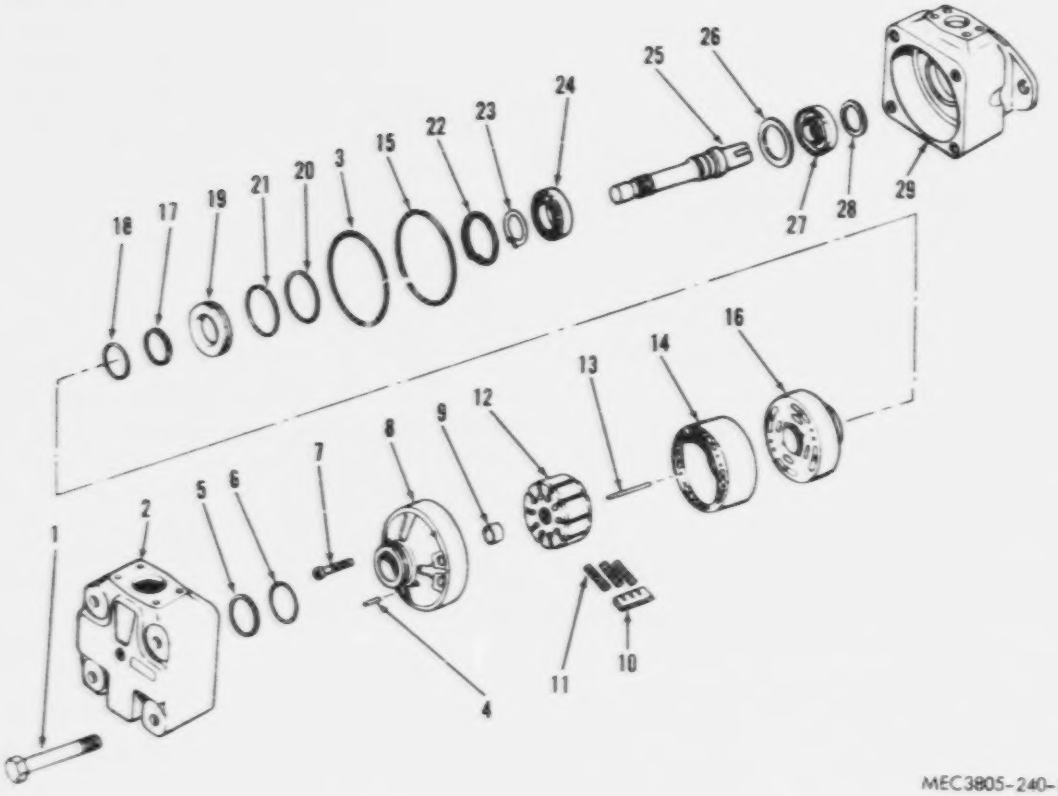
(*b*) Apply pressure and hold from 30 to 45 seconds. Check seals for leaks. Disassemble valve and replace seals if leaks are observed.

e. Reassembly. Reassemble the crowd drive pump start-stop valve in reverse of numerical sequence illustrated on figure 8-21.

(1) To prevent cutting seal on sharp edges, wrap spool (6) in 3 or 4 layers of glossy paper, leaving only the front seal groove exposed. Install new seal from rear of spool over paper and into front seal groove.

(2) Assemble knob and lockwasher on spool.

(3) Apply clean grease to seal, remove paper, and insert spool in housing (8), using a



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1	Bolt (4 rqr)	11	Spring (30 rqr)	21	Packing, preformed
2	Cover	12	Rotor	22	Ring, lock
3	Packing, preformed	13	Pin (2 rqr)	23	Ring, retaining
4	Pin (2 rqr)	14	Ring	24	Bearing
5	Ring, back-up	15	Packing, preformed	25	Shaft
6	Packing, preformed	16	Plate, pressure	26	Washer
7	Screw (2 rqr)	17	Ring, back-up	27	Seal, shaft
8	Plate, pressure	18	Packing, preformed	28	Wiper, felt
9	Bushing	19	Adapter, hub	29	Body
10	Vane (10 rqr)	20	Ring, back-up		

Figure 8–20. Crowd drive motor, exploded view.

rotating action. Push in spool until front seal disappears and rear seal groove appears.

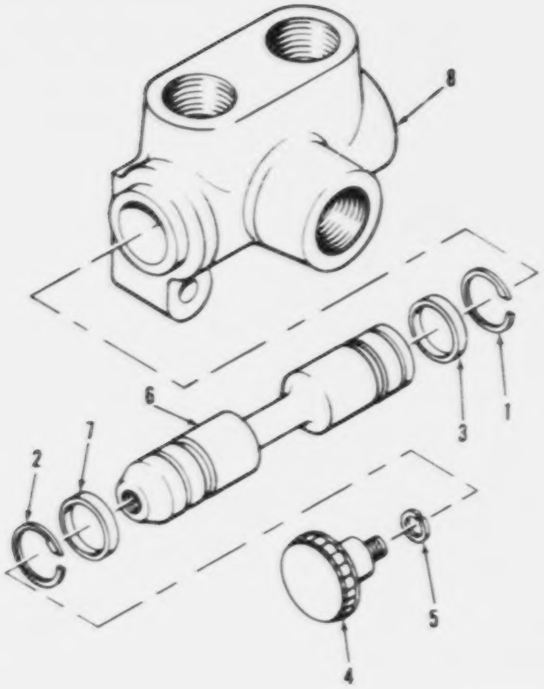
(4) Install rear seal and apply clean grease.

(5) Install rear retaining ring (1), and with firm rotating action, pull spool to stop.

(6) Install front retaining ring (2).

(7) Test valve assembly for leaks.

f. Installation. Install crowd drive pump start-stop valve (para 2–48).



1	Ring, retaining	5	Washer, lock
2	Ring, retaining	*6	Spool
3	Seal	7	Seal
4	Knob control	*8	Housing

*These items are issued as matched sets.

Figure 8-21. Crowd drive pump start-stop valve assembly, exploded view.

Section IV. CONVEYOR BELT DRIVE HYDRAULIC SYSTEM

8-17. General

The conveyor belt drive hydraulic system includes a free flow, single spool directional control valve; a variable displacement axial piston-type drive pump; and two gear-type motors. The pump draws fluid from the main hydraulic reservoir to supply the two motors. The motors drive the conveyor belt. Direction of rotation of the belt is manually controlled by means of the conveyor drive directional control valve.

8-18. Conveyor Belt Drive Directional Control Valve

a. General. The conveyor belt drive directional control valve is a four-way free-flow, single-spool unit, containing an integral pressure relief valve for system protection. The primary purpose of the valve is to change the direction in which the two conveyor drive motors rotate. The integral relief valve bypass fluid to the hydraulic system reservoir at about 2000 psi.

b. Removal. Remove the conveyor drive directional control valve (para 2-48).

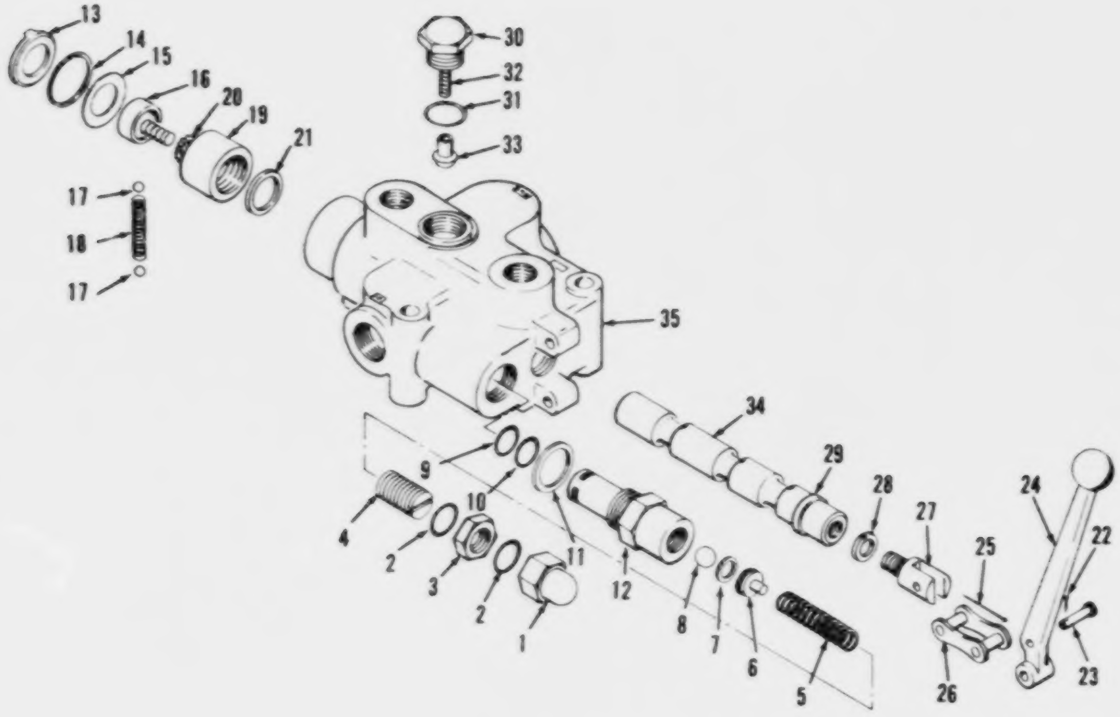
c. Disassembly. Disassemble the conveyor drive directional control valve in the numerical sequence as illustrated on figure 8-22.

***Caution:* Before disassembly, close all ports with plastic caps. Be sure work area is clean.**

Note. Discard and replace all seals and performed packing.

***Warning:* Use care when removing adjusting screw (4). The relief spring (5) may be expelled with great force.**

(1) Remove cap assembly (13 through 19).



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1	Cap, acorn	13	Cap assembly	25	Pin, cotter
2	Washer, seal (2 rqr)	14	Ring, retaining	26	Link, handle
3	Nut, jam	15	Washer, stop	27	Adapter, handle
*4	Screw, adjusting	*16	Holder, detent	28	Washer, lock
*5	Spring, relief (1501-2000 psi)	*17	Detent, ball (2 rqr)	29	Seal, spool
6	Guide, relief ball	*18	Spring, detent	30	Plug
7	Seal, ball guide	19	Sleeve, detent	31	Packing preformed
8	Ball, relief	20	Washer, lock	32	Spring, poppet
9	Packing, preformed	21	Seal, spool	33	Poppet
10	Washer, back-up relief	22	Pin, cotter	**34	Spool
11	Packing, preformed	23	Pin, clevis	**35	Housing
12	Body, relief valve	24	Handle		

*These items are removed as an assembly from the valve housing, then disassembled.
**These items supplied as a matched set only.

Figure 8-22. Conveyor belt directional valve, exploded view.

Note. Cap assembly has two "ears" and is pressed into the valve. Use pliers to pull out.

(2) Disassemble handle assemble (19 through 28) and related parts.

(3) Pull spool toward front. Remove back seal (21).

***Caution:* Move spool only until back is exposed.**

(4) Push spool in opposite direction until front seal is exposed. Remove front seal (29).

(5) Remove spool.

(6) Remove check plug assembly (30 through 33).

d. Cleaning. Clean all parts with an approved cleaning solvent and air dry.

e. Inspection and Repair.

(1) Replace all seals, preformed packing, and retaining rings.

(2) Test relief spring (5) with a spring tester. Inspect for cracks or other damage and replace if weak or defective.

(3) Inspect relief ball (8) and detent balls (17) for wear and out-of-roundness. Replace if worn or damaged.

(4) Inspect springs (18, 32) for wear, breaks, and weakness. Replace if defective.

(5) Inspect spool (34) and housing (35) for wear, cracks or other deterioration. Replace these items as a matched set if defective.

f. Reassembly. Reassemble the conveyor belt drive directional control valve in reverse of numerical sequence illustrated on figure 8-22.

(1) Replace packings (21) and (29) and spool (34) as follows.

(*a*) Install spool (34).

(*b*) Install new front packing (29). Insert packing so that open end is placed toward center of valve body.

Note. Lightly pinch one side of packing to bend into shape slightly smaller than the packing groove in valve. When packing has been properly placed in groove, straighten by running a smooth rod around exposed surface of packing. Check for even seating by running finger around the exposed edge.

***Caution:* Apply a small amount of heavy oil on the packing to prevent tearing during assembly.**

(*c*) Insert the internally chamfered end of the packing tool (fig. 2-2) into the spool bore of the valve and through the new packing. Push spool forward until the spool and tool contact. Push spool further forward against tool until rear spool groove is completely exposed but not further. Remove tool.

(*d*) Install back packing (21) and apply grease. Insert packing tool (internally chamfered end first) carefully into back bore through packing until it makes contact with spool. From front side push spool back one-half inch. Remove tool.

(2) Reassemble handle assembly and related parts.

(3) Reassemble bonnet cap assembly and related parts.

(4) Reassemble check plug and related parts.

(5) Reassemble relief assembly.

(6) Test run valve assembly, using hydraulic oil specified in LO 5-3805-240-12.

Note. Relief valve must be set for 2000 psi with a total pressure drop of 45 psi at 20 GPM through two of the valve working ports. Maximum drop must be 7 psi at 20 GPM through "open center".

g. Installation. Install the conveyor belt drive directional control valve, (para 2-48).

8-19. Conveyor Belt Drive Pump Assembly

a. General. The conveyor belt drive pump is a variable displacement, exial piston unit. The pump is used to drive the two reversible conveyor belt motors. The shaft of the pump operates at engine speed (fig. 8-23). The shaft turns a rotating group assembly which includes a cylinder block, nine pistons, and nine shoes. The shoes ride against a swash plate, forcing the pistons in and out of the cylinder block. As a piston passes the inlet port in the valve plate assembly, it is moving out of the cylinder block, and fluid enters the cylinder. As the piston passes the outlet port, it is moving into the cylinder block and forces the fluid out. The angle of the swash plate is determined by the angle of the yoke. By changing the angle of the yoke, piston travel and hence pump displacement can be varied. Yoke angle is adjusted by means of a lever (40, fig. 8-24).

b. Removal. Remove the conveyor belt drive pump (para 2-48).

c. Disassembly. Disassemble the conveyor belt drive pump in the numerical sequence as illustrated on figure 8-24. Refer to steps below for additional instructions.

(1) Remove adapter (6) valve plate (12) and associated parts.

***Caution:* In removing the rotating group assembly (15), make sure that the piston and shoe assemblies (16) do not separate from the cylinder (25).**

(2) Turn rotating group assembly slightly to free it from swash plate (26). Tilt housing (2) and remove rotating group assembly.

(3) Carefully lift each piston and shoe assembly from cylinder.

***Caution:* Keep pistons from striking one another or other hard objects. Even a minor burr on a piston can severely score the cylinder block.**

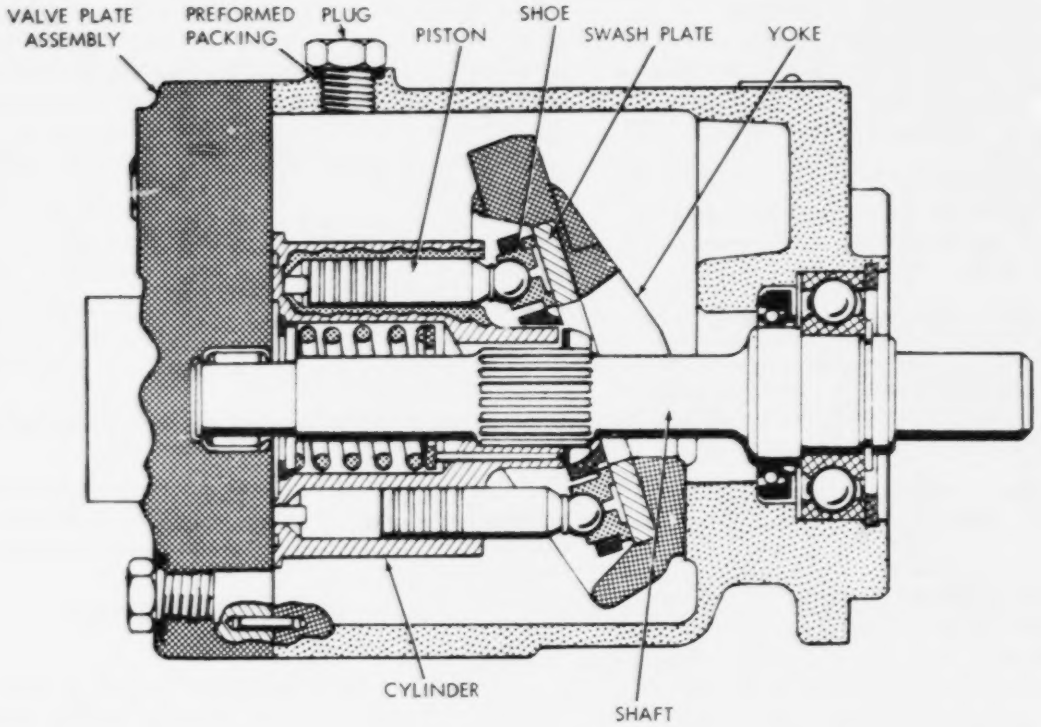
***Warning:* Bodily injury can result from sudden release of the cylinder spring (23).**

Note. The outside diameter of the swash plate (26, fig. 8-24) is smaller than the inside diameter of the recess in the yokes (36). A properly seated switch plate can be freely rotated with the fingertips. Removal may be slightly difficult because of oil suction under the swash plate.

(4) If the spring and washers are to be removed from the cylinder, follow the procedure illustrated on figure 8-25.

(5) Rotate swash plate and pull out evenly from yoke.

(6) Remove retainer snap ring (27) with snap ring pliers. Tap end of drive shaft (28) with a soft-tipped hammer to free shaft from bearing (42) housing.



MEC3805-240-35/8-23

Figure 8-23. Conveyor belt drive pump assembly, cross section.

(7) Remove yoke (36) according to procedure illustrated on figure 8-26.

d. Cleaning. Clean all parts thoroughly with a mineral oil cleaning solvent prior to inspection and after any lapping or machining operating. Air dry all parts.

e. Inspection and Repair.

(1) Inspect valve plate (12, fig. 8-24) for wear and scoring. If wear or scoring is extensive, replace valve plate. Lapping is not permissible.

(2) Inspect bores and valve plate mating surface of cylinder (25) for wear and scoring. If wear or scoring is extensive, replace cylinder.

Note. The valve plate mating surface of the cylinder can be refinished. If machining is required, not more than 0.010 of an inch should be removed prior to lapping.

(3) Inspect piston and shoe assemblies (16) for wear and damage. Check shoe face-to-back shoulder dimensions of all nine assemblies as shown in figure 8-27. A variation greater than 0.001 inch between shoes will result in excessive wear. If any piston and shoe assembly is defective, all nine assemblies must be replaced.

(4) Replace swash plate (26, fig. 8-24) if there is any evidence of wear or scoring.

(5) Inspect all bearings for roughness and excessive end play and replace if necessary.

(6) Inspect seal journal of shaft (28) for wear and scoring and replace if excessive.

f. Reassembly.

Note. Reassemble the conveyor belt drive pump in the reverse of the numerical sequence illustrated on figure 8-24. Refer to steps 1 through 10, below, for detailed information.

(1) Replace old gaskets, oil seal, and preformed packing with new parts.

(2) Apply a light film of clean hydraulic fluid to ease reassembly and to provide initial lubrication.

(3) Install yoke (36) in housing (2) in reverse of sequence illustrated on figure 8-26. Torque the screws (31) to 20-25 ft-lb.

(4) Install oil seal (44) in housing with spring toward yoke. Place retainer (43) over seal and then install drive shaft (28) in housing. Secure drive shaft bearings (42) with retaining rings (27 and 41).

(5) Install swash plate (26) in yoke. It is important that swash plate be properly seated and can be freely rotated with the fingers.

(6) Assemble spring (23) and washers (22 and 24) in cylinder block (25) in reverse of sequence illustrated on figure 8-25.

(7) Place cylinder block face down on a smooth, clean surface. Insert three pins (20, fig. 8-24) in cylinder block. Grease back-up washer (19) and spherical washer (18) and place on pins.

***Caution:* Make certain that the piston and shoe assemblies do not strike one another or any other hard object.**

(8) Put nine piston and shoe assemblies in shoe plate (17). Carefully holding shoe plate so that pistons do not strike one another, aline pistons with bores and maneuver them into place. Each piston must move freely in a lubricated block bore.

(9) Apply pressure to cylinder block and shoe plate to keep pins, washer, and spherical washer intact and install rotating group onto drive shaft.

Note. Slight rotation during assembly will help align the spherical washer and cylinder block splines with those of the drive shaft.

(10) Install valve plates (12), adapter (6), and associated parts. Torque screws (11) to 25-35 ft-lb.

g. Installation. Install the conveyor belt drive pump (para 2-48).

8-20. Conveyor Belt Drive Motor Assemblies

a. General. The conveyor drive motors are reversible gear-type motors used to drive the spoil conveyor belt. One motor is used as each end of the conveyor. Both motors operate simultaneously. The direction of hydraulic fluid flow through the motors determine which way the belt carries the spoil. The shaft originally supplied with the motor is not used. Instead, the motor connects directly to the conveyor end drum drive shaft (fig. 8-28). Hydraulic fluid under pressure enters one of the two ports in the sides of the gear housing (5). This pressure is effective on the top and bottom teeth of the drive gear (3) and driven gear (4). The force on the bottom tooth of the driven gear complements the force on the top tooth of the drive gear. This combined force is twice that produced where the gears mesh, since only one tooth surface is exposed at a time. This produces rotation of the conveyor and drum drive shaft (8).

b. Removal. Remove the conveyor belt motor (para 2-48).

c. Disassembly.

(1) Scribe port end cover (3, fig. 8-29), gear housing (11), and shaft end cover (19) to show proper position of these items for reassembly.

(2) Disassemble conveyor drive motor in numerical sequence illustrated on figure 8-29. Pry off thrust plates (4 and 13) with a knife blade or thin screwdriver. Pull out bearings (6, 7, 15 and 16) with a bearing puller only if they are to be replaced or if the spring (17) or bushing (18) requires replacement.

d. Cleaning. Clean all parts thoroughly with a mineral oil cleaning solvent prior to inspection and after any stoning.

e. Inspection and Repair.

(1) Discard gaskets (10 and 12, fig. 8-29) and pocket seals (5 and 14). Replace with new parts.

(2) Examine gears (8 and 9), thrust plates (4 and 13), and gear housing (11) for wear and burrs. Remove burrs from ends of gears and housing surfaces by honing.

(3) Check (6, 7, 15 and 16) bearings for wear and flat spots.

(4) Check end covers (3 and 19) and gear housing for cracks and other damage.

(5) Replace weak or damaged spring and replace any other defective parts. If one gear is damaged, replace both gears at the same time.

f. Reassembly.

Note. Observe the markings made prior to disassembly and properly position the port end cover (3, fig. 8-29), gear housing (11), and shaft end cover (19).

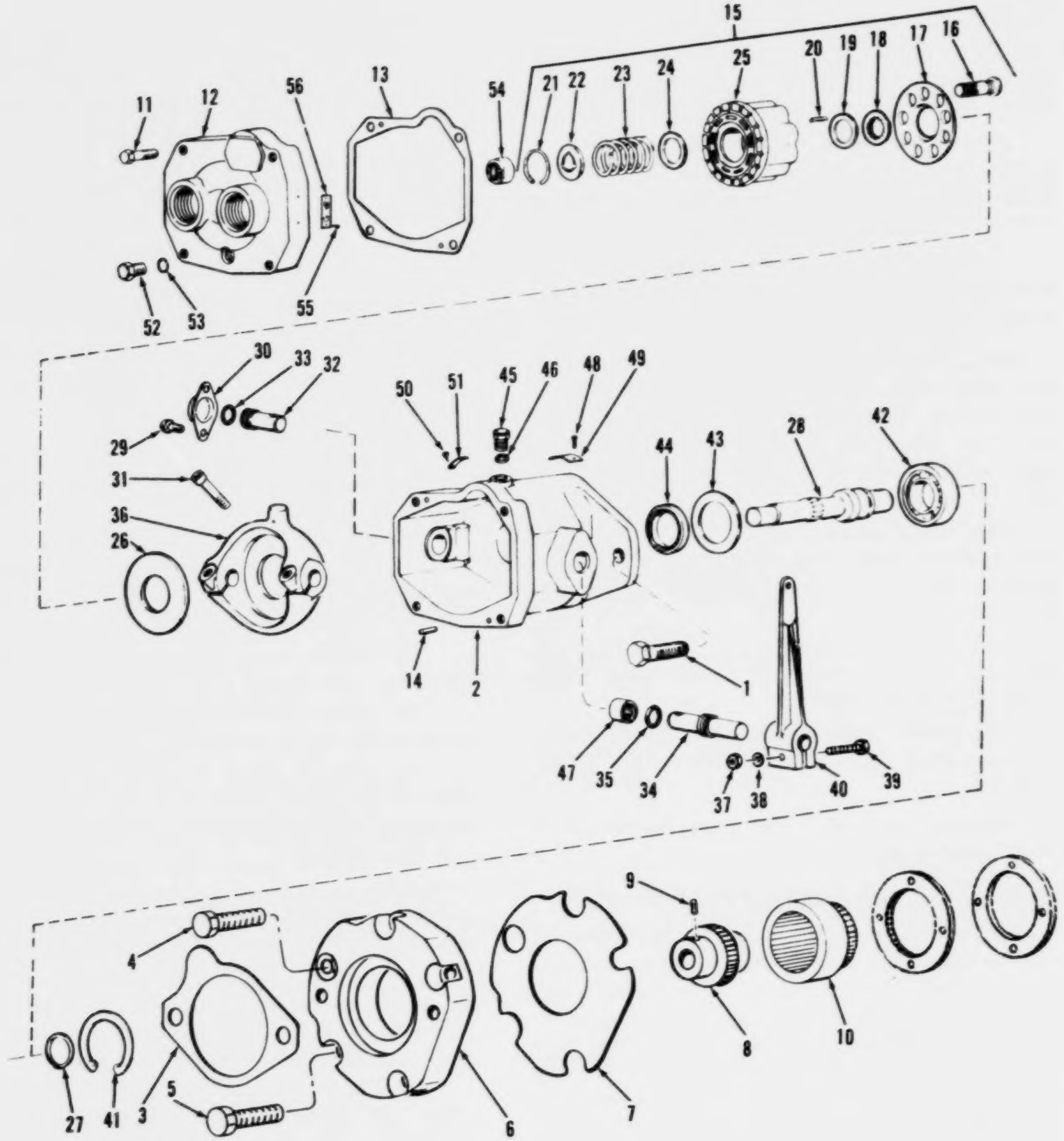
(1) Install bronze shaft bushing (18) in shaft end cover (19) with flange side toward bottom of bore. Install small end of spring (17) over pilot shoulder of shaft bushing.

(2) Press bearings (15 and 16) in place in shaft end cover. Be sure top of spring is not wedged between bearing and bottom of bearing counterbores.

(3) Place a small amount of heavy grease in the two middle slots of thrust plate (13) and insert two pocket seals (14).

(4) Place thrust plate over bearings with two pocket seals toward shaft end cover. Check that seals are still in place before tapping thrust plate into position. Leave 1/32-inch clearance between thrust plate and shaft end cover.

(5) Insert a pocket seal into each of four open slots in thrust plate. Push each seal all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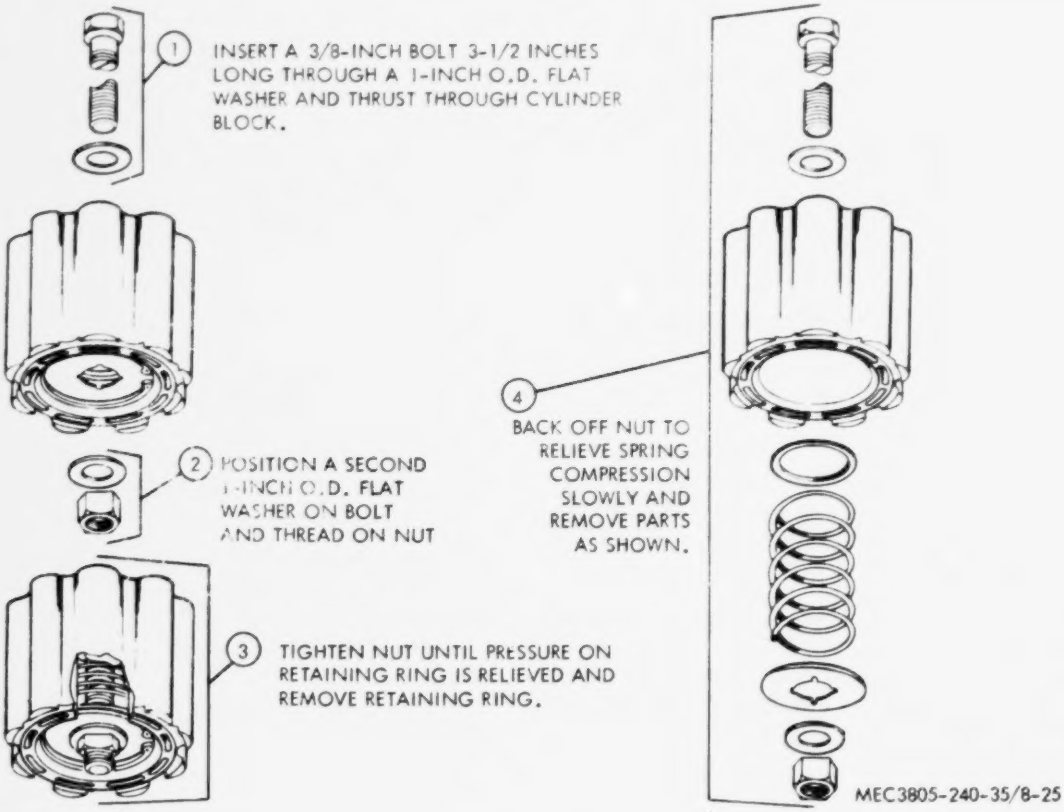
MEC3805-240-35/8-24

1 Screw (2 rqr)
2 Housing
3 Gasket
4 Screw, 7/16-14 x 1 in.
5 Screw, 1/2-13 x 1 in. (4 rqr)
6 Adapter
7 Gasket
8 Coupling
9 Screw, set, 5/16-18 x 3/8 in.

Figure 8-24. Conveyor belt drive pump, exploded view.

10 Coupling, drive
11 Screw, (4 rqr)
12 Plate, valve (4 rqr)
13 Gasket
14 Pin, dowel (2 rqr)
15 Rotating group assembly
16 Piston and shoe assembly (9 rqr)
17 Plate, shoe
18 Washer, spherical
19 Washer, back-up
20 Pin (3 rqr)
21 Ring , retaining
22 Washer
23 Spring
24 Washer, thrust
25 Cylinder
26 Plate, swash
27 Ring, retaining
28 Shaft
29 Screw (2 rqr)
30 Cover
31 Screw (2 rqr)
32 Pintle
33 Packing, preformed
34 Pintle
35 Packing, preformed
36 Yoke
37 Nut
38 Washer, lock
39 Screw
40 Lever
41 Ring, retaining
42 Bearing
43 Retainer
44 Seal
45 Plug
46 Packing, preformed
47 Bearing (2 rqr)
48 Screw (2 rqr)
49 Nameplate
50 Screw (2 rqr)
51 Plate, instruction
52 Plug
53 Packing, preformed
54 Bearing
55 Screw (2 rqr)
56 Plate, rotation

Figure 8-24—Continued


① INSERT A 3/8-INCH BOLT 3-1/2 INCHES LONG THROUGH A 1-INCH O.D. FLAT WASHER AND THRUST THROUGH CYLINDER BLOCK.

② POSITION A SECOND 1-INCH O.D. FLAT WASHER ON BOLT AND THREAD ON NUT

③ TIGHTEN NUT UNTIL PRESSURE ON RETAINING RING IS RELIEVED AND REMOVE RETAINING RING.

④ BACK OFF NUT TO RELIEVE SPRING COMPRESSION SLOWLY AND REMOVE PARTS AS SHOWN.

Figure 8-25. Conveyor belt drive pump cylinder disassembly.

the way in so that hidden end is in contact with roller bearing race.

(6) Tap thrust plate into position against shaft end cover. Use a sharp knife or razor blade to trim off excess from exposed ends of seals. Trim square and flush with side of thrust plate.

(7) Place bearings (6 and 7) in place in port end cover. Install thrust plate (4) and pocket seals (5) over bearings in manner described in steps (3) through (6).

(8) Pour a small amount of oil on thrust plate (13) for initial lubrication. Position drive gear (9) through thrust plate with splines facing shaft opening in shaft end cover. Position driven gear (8)

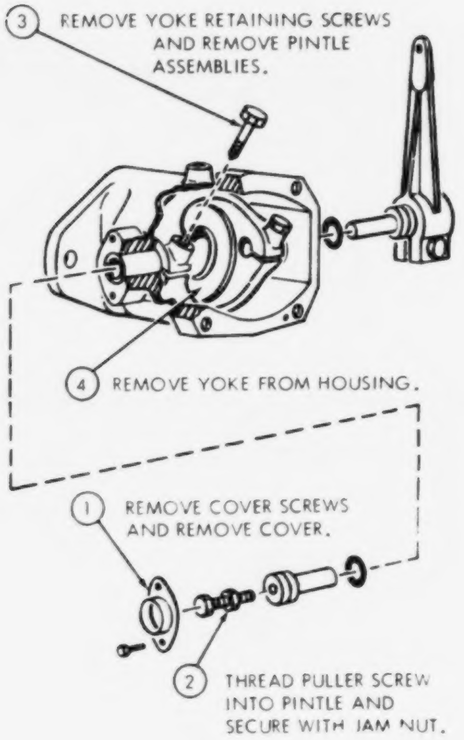

③ REMOVE YOKE RETAINING SCREWS AND REMOVE PINTLE ASSEMBLIES.
④ REMOVE YOKE FROM HOUSING.
① REMOVE COVER SCREWS AND REMOVE COVER.
② THREAD PULLER SCREW INTO PINTLE AND SECURE WITH JAM NUT.

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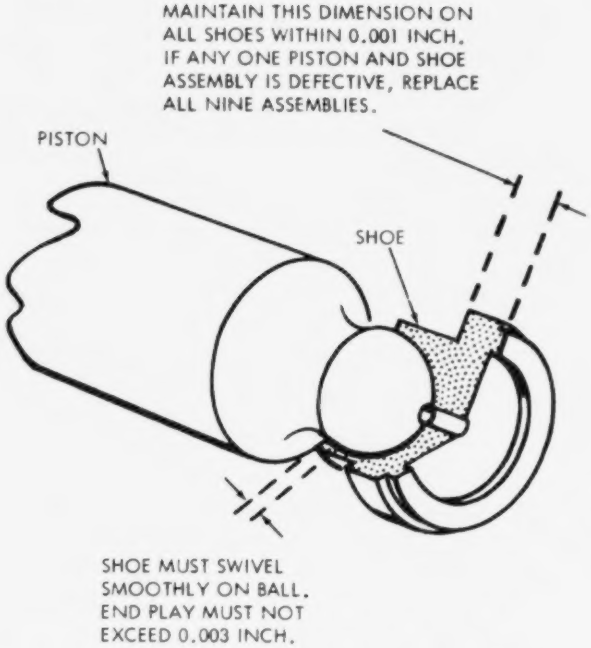
Figure 8-26. Conveyor belt drive pump pintle and yoke, removal.


MAINTAIN THIS DIMENSION ON ALL SHOES WITHIN 0.001 INCH. IF ANY ONE PISTON AND SHOE ASSEMBLY IS DEFECTIVE, REPLACE ALL NINE ASSEMBLIES.
PISTON
SHOE
SHOE MUST SWIVEL SMOOTHLY ON BALL. END PLAY MUST NOT EXCEED 0.003 INCH.

MEC3805-240-35/8-27

Figure 8-27. Conveyor belt drive pump piston and shoe assembly tolerance limits.

(9) Grease gaskets (10 and 12) and install in grooves in gear housing (11). Place housing on shaft end cover and tap into position with a soft (plastic or leather) hammer. Be careful not to pinch gasket.

(10) Pour a small amount of oil over gears for initial lubrication. Install port end cover (3) on gear housing. Use a soft hammer to seat port and cover against housing. Be careful not to pinch gasket.

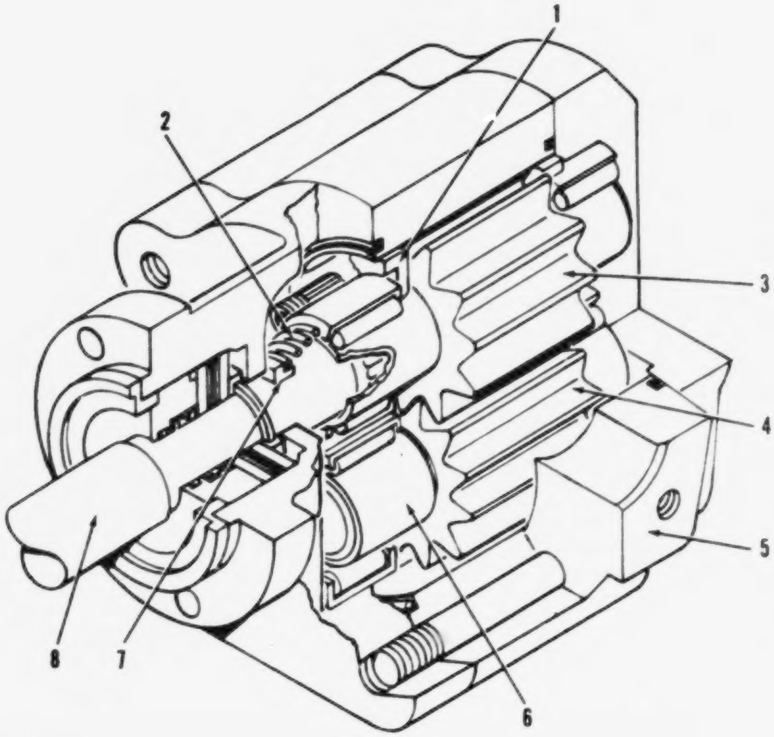
(11) Install four bolts (1) with washers (2) and tighten evenly. Torque bolts to 200 ft-lb.

g. Installation.

Note. Replacement conveyor drive motors are equipped with a retaining ring and drive shaft which must be removed and discarded.

(1) Remove retaining ring and pull out shaft.

(2) Install conveyor drive motor (para 2-48).



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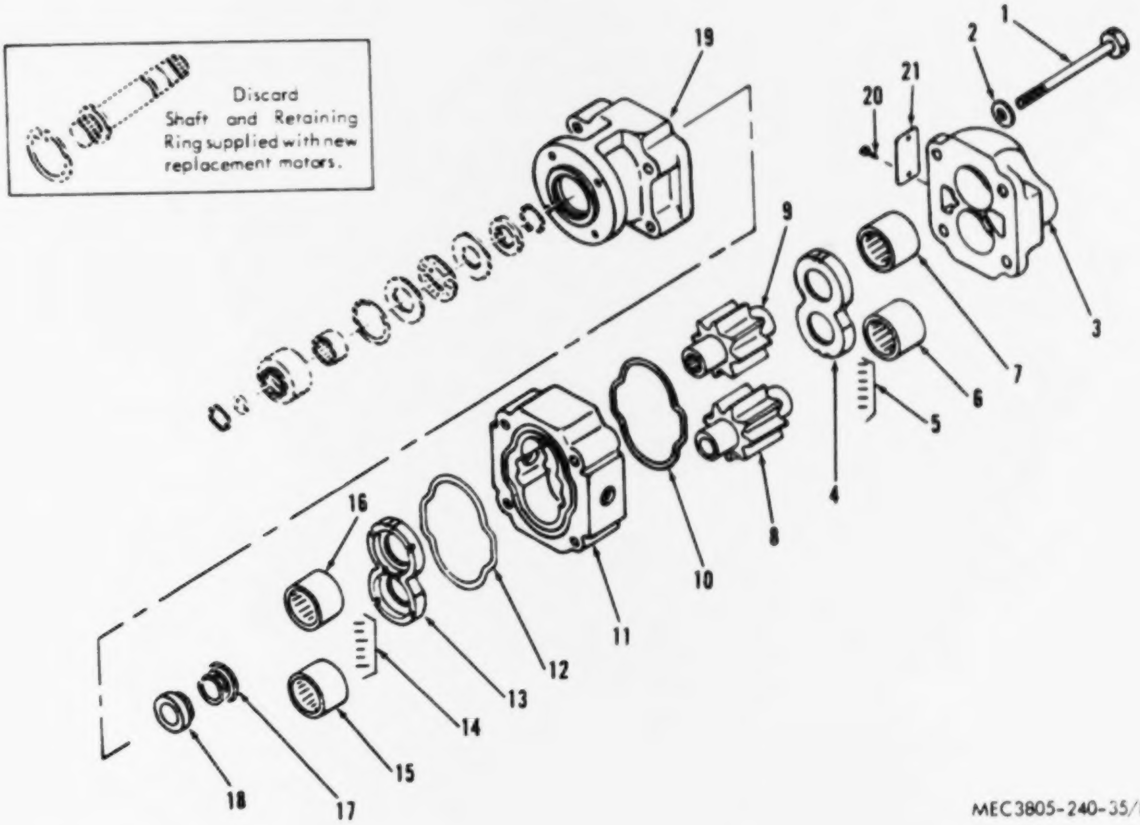
1 Plate, thrust	3 Gear, driven	5 Housing	7 Bushing, shaft
2 Spring	4 Gear, drive	6 Bearing, roller	8 Shaft—part of conveyor end drum

Figure 8-28. Conveyor drive motor, cutaway view.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Shaft and Retaining
Ring supplied with new
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MEC3805-240-35/8-29

1	Bolt (4 rqr)
2	Washer (4 rqr)
3	Cover, port end
4	Plate, thrust
5	Seal, pocket (6 rqr)
6	Bearing, roller
7	Bearing, roller
8	Gear, driven
9	Gear, drive
10	Gasket
11	Housing, gear
12	Gasket
13	Plate, thrust
14	Seal, pocket (6 rqr)
15	Bearing, roller
16	Bearing, roller
17	Spring
18	Bushing, shaft
19	Cover, shaft end
20	Screw, drive (2 rqr)
21	Nameplate

Figure 8-29. Conveyor drive motor, exploded view.

CHAPTER 9

AIR SYSTEM REPAIR INSTRUCTIONS

Section I. GENERAL

9-1. Air System Components

Figure 9-1 shows connections to all components which make up the air system of the ditcher. This figure, together with the schematic diagram (fig. 9-2), can be used on analyze and locate air system malfunctions. Subsequent sections of this chapter cover repair of all components in the air system except the alcohol evaporator, air pressure gage, horn, and operator seat. The alcohol evaporator, air pressure gage, and horn are covered in TM 5-3805-240-12. The operator seat is covered in paragraph 13-13.

9-2. Component Functions (fig. 9-2)

a. Compressor Assembly. The compressor assembly (34) operates whenever the engine is running. Compression of air is controlled by the governor (35), which operates in conjunction with the compressor unloading mechanism. The air intake is through an alcohol evaporator which introduces alcohol vapors. This prevents freeze-up of condensation in cold weather.

b. Air System Governor. The governor (35) senses system pressure by a connection to the front reservoir (28). The governor starts and stops air compression by removing or applying air pressure to the compressor unloading mechanism.

c. Brake Valve. The foot operated brake valve (18) meters the flow of compressed air to the brake chambers, thus controlling the degree of brake application. The valve also provides connection of system air pressure to several other components.

d. Brake Chamber. The brake chambers (23, 32, 42 and 45) operate in the service mode or emergency mode. With no air to a chamber, the brake is applied due to spring action in the chamber. This is the emergency or parking brake mode. Emergency brakes are released by applying pressure through the quick release valves (22). In the service mode, air pressure from the brake valve causes application of the brakes.

e. Quick Release Valve. The quick release valves (22) speed up the release of air pressure from the spring brake sections of the brake chambers (23, 32, 42 and 45). Air from a chamber exhausts through the quick release valve instead of back through connecting lines.

f. Limiting and Quick Release Valve. Like the quick release valve, the limiting and quick release valve (33) speeds up the release of air pressure from the two front brake chambers (23 and 32). The valve also has a limiting feature which is used in slippery-road conditions. This reduces the application pressure from the brake valve (18) to fifty percent at the front brake chambers. During dry-road conditions, the full brake application pressure appears at the brake chambers.

g. Relay Valve. The relay valve (43) speeds up the application and release of the rear wheel brakes. The relay valve has a direct connection to service air pressure and is controlled by the brake valve (18). The relay valve reacts to any change in brake valve pressure to raise, lower, or exhaust air pressure from the two rear brake chambers 42 and 45.

h. Power Cluster Assembly. The power cluster assemblies (1) convert moderate air pressures to relatively high hydraulic pressures at a ratio of 15:1. The hydraulic pressure operates clutches in the transfer case to control bucket line operation and differential lock-up.

i. Pilot Air Valve. The pilot air valve (3) is normally open, allowing operation of the bucket line. When the ditcher is operated in 4th, 5th, or 6th gear, a cam on the transmission closes the valve to prevent bucket line operation.

j. Differential Lock-up Fluid Pressure Regulating Valve Assembly. The differential lockup regulating valve assembly (11) cuts off air for differential lock-up if system pressure falls below 60 psi. This conserves air pressure for brake applications.

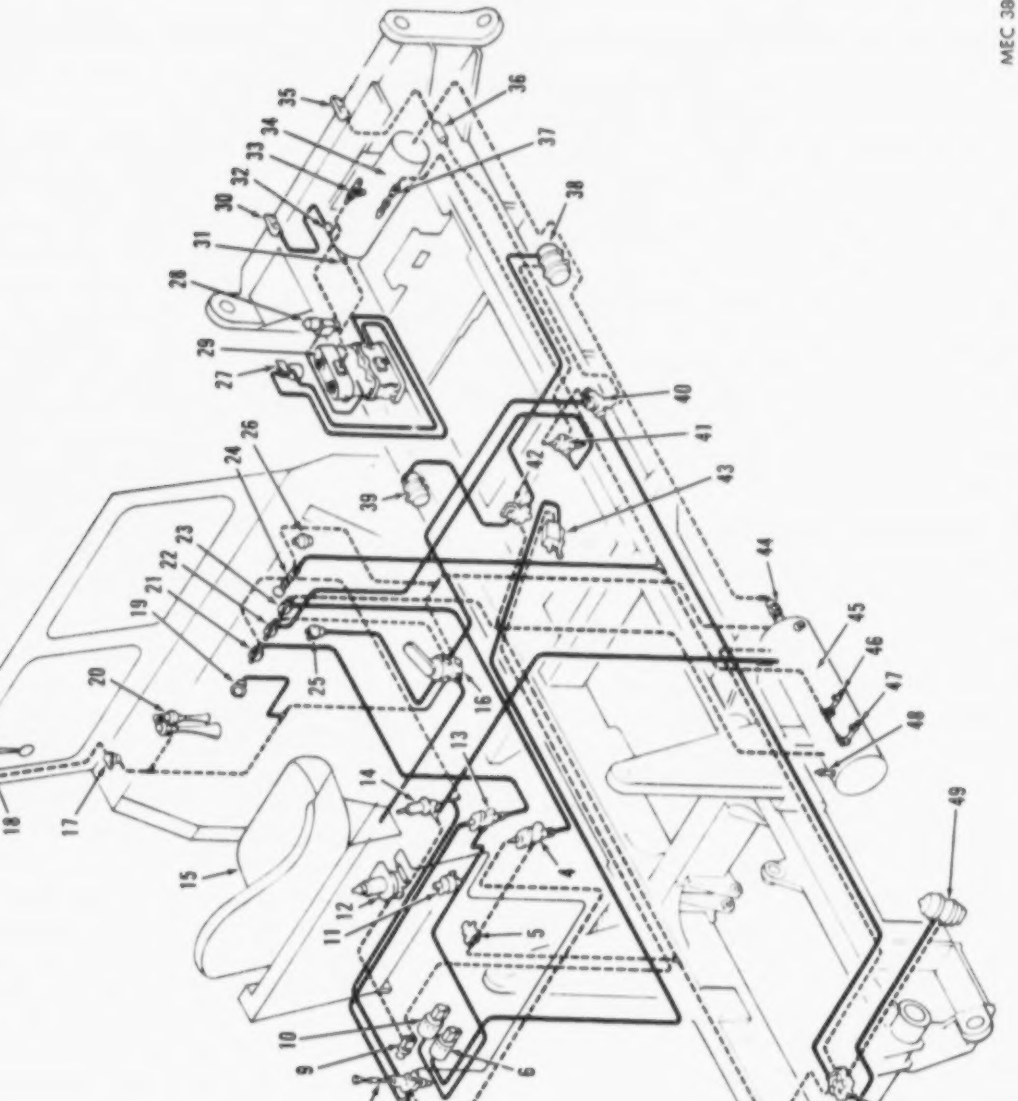
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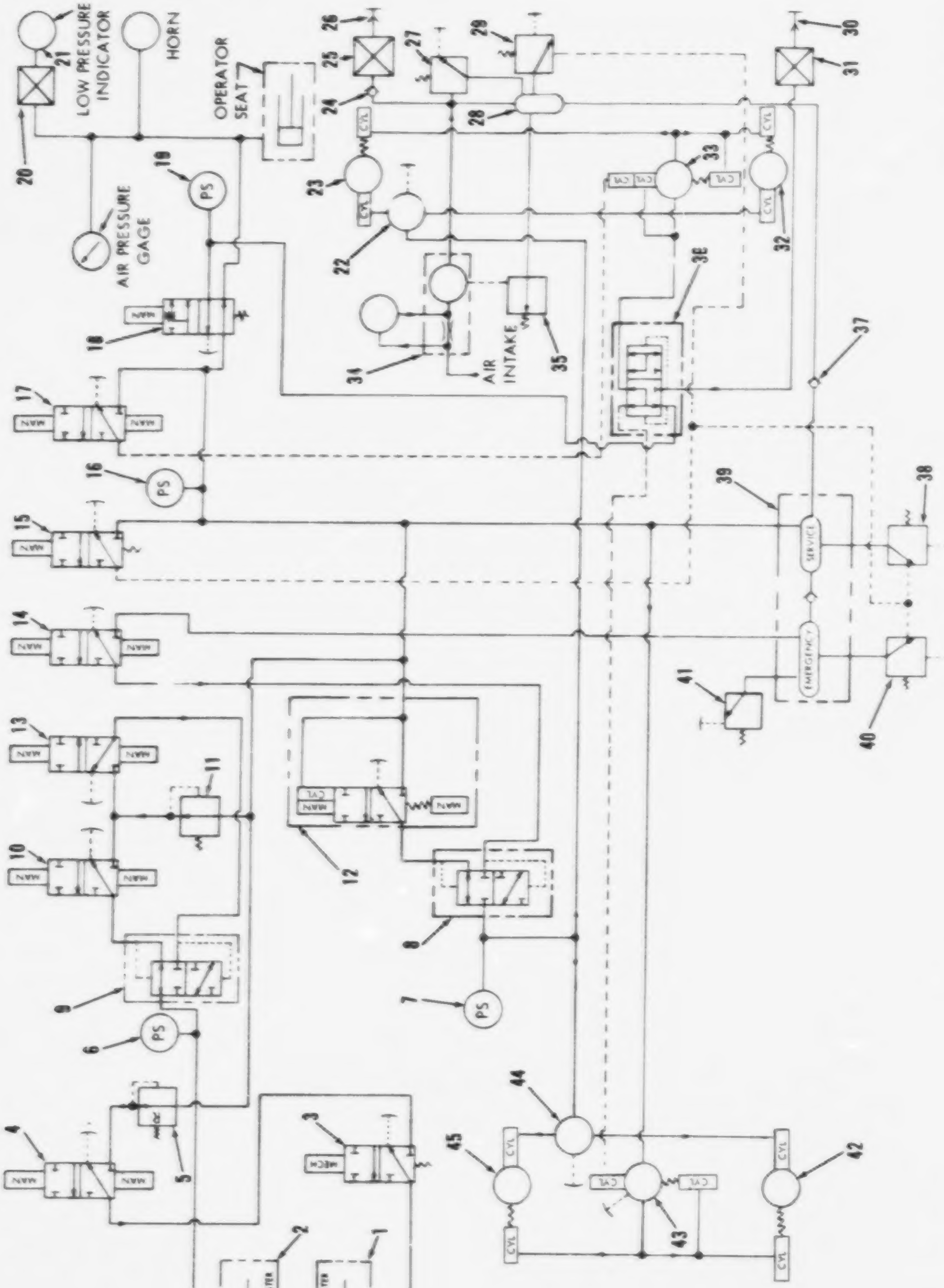
Figure 9-1. Air system connection diagram.

1	Left rear brake chamber
2	Rear quick release valve
3	Relay valve
4	Emergency brake double check valve
5	Emergency brake pressure switch
6	Bucket line power cluster assembly
7	Interaxle lock-up toggle type control valve
8	Emergency brake push-pull control valve
9	Bucket line control push-pull control valve
10	Interaxle lock-up power cluster assembly
11	Interaxle lock-up pressure switch
12	Bucket line air regulator assembly
13	Interaxle lock-up double check valve
14	Interaxle lock-up fluid pressure regulating valve assembly
15	Operator seat
16	Brake valve
17	Indicator shut-off valve
18	Low air pressure indicator
19	Air pressure gage
20	Horn
21	Interaxle lock-up toggle type control valve
22	Front brake limiter toggle type control valve
23	Emergency brake toggle type control valve
24	Drain control push valve
25	Stop Light pressure switch
26	Low pressure switch
27	Alcohol evaporator
28	Air system governor
29	Compressor assembly
30	Emergency automatic towing hose coupling assembly
31	Single check valve
32	Hose coupling shut-off cock
33	Safety valve
34	Single compartment air reservoir
35	Service automatic towing hose coupling assembly
36	Hose coupling shut-off cock
37	Drain valve
38	Right front brake chamber
39	Left front brake chamber
40	Service brake double check valve
41	Limiting and quick release valve
42	Front quick release valve
43	Pilot air valve
44	Single check valve
45	Two-compartment air reservoir
46	Drain valve
47	Drain valve
48	Safety valve
49	Right rear brake chamber

Figure 9-1—Continued


LOW PRESSURE INDICATOR
HORN
OPERATOR SEAT
AIR PRESSURE GAGE
AIR INTAKE
SERVICE
EMERGENCY
POWER CLUSTER
POWER CLUSTER
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MEC3805-240-35/9-2

Figure 9-2. Air system schematic diagram.

1	Bucket line power cluster assembly
2	Differential lock-up power cluster assembly
3	Pilot air avlve
4	Bucket line control push-pull air valve
5	Bucket line air regulator assembly
6	Differential lock-up pressure switch
7	Emergency brake pressure switch
8	Emergency brake double check valve
9	Differential lock-up double check valve
10	Differential lock-up toggle type control valve
11	Differential lock-up fluid pressure regulating valve assembly
12	Emergency brake push-pull air valve
13	Differential lock-up toggle type control valve
14	Emergency brake toggle type control valve
15	Drain control push valve
16	Low pressure switch
17	Front brake limiter toggle type control valve
18	Brake valve
19	Stop light pressure switch
20	Indicator shut-off valve
21	Low air pressure indicator
22	Front quick release valve
23	Front brake chamber
24	Single check valve
25	Hose coupling shut-off cock
26	Automatic towing hose coupling assembly
27	Safety valve
28	Single compartment air reservoir
29	Drain valve
30	Automatic towing hose coupling assembly
31	Hose coupling shut-off cock
32	Front brake chamber
33	Limiting and quick release valve
34	Compressor assembly
35	Air system governor
36	Service brake double check valve
37	Single check valve
38	Drain valve
39	Two-compartment air reservoir
40	Drain valve
41	Safety valve
42	Rear brake chamber
43	Relay valve
44	Rear quick release valve
45	Rear brake chamber

Figure 9-2—Continued

k. Bucket Line Air Regulator Assembly. The bucket line air regulator assembly (5) provides a critically adjusted 15 psi for operation of the bucket line power cluster assembly (1). This adjustment permits the clutch in the transfer case to slip if the bucket line encounters a serious obstruction.

l. Safety Valve. The two safety valves (27 and 41) are set to open when reservoir pressure goes above 150 psi. On the two compartment air reservoir (39), the valve is mounted on the emergency compartment since the air flow is from the service compartment to the emergency compartment through a check valve. An excessive pressure buildup in either compartment, due to temperature variations or other causes, is thus relieved through the valve.

m. Drain Valve. The three drain valves (29, 38 and 40) are used to drain off water and oil which condense in the air reservoirs. The valves are normally closed and open only when air pressure is applied from a control valve in the operator compartment.

n. Air Reservoirs. The single compartment (wet) air reservoir (28) receives air directly from the compressor assembly (34). Most of the condensation occurs in this reservoir. The two compartment air reservoir (39) supplies all normally used air from the service compartment. An integral check valve between compartments keeps the emergency compartment at system pressure. The emergency supply allows the emergency brakes to be released if service air pressure is lost.

o. Check Valves. Two single check valves (24 and 37) are used in the system. One valve blocks any reverse air flow from the service compartment of the two-compartment air reservoir (39), thus protecting the air supply against any frontend malfunction. The other single check valve prevents air loss through the emergency coupling assembly (26). The three double check valves (8, 9 and 36) provide air pressure on one or two output lines from either of two input lines. The two input lines are isolated from each other by an internal shuttle valve.

p. Pressure Switches. Four pressure sensitive electrical switches are used in the system. The differential lock-up switch (6) and stop light switch (19) have normally open contacts. Air pressure in their lines produces a visual indication. The emergency brake switch (7) and low pressure switch (16) have normally closed contacts. The emergency brake switch produces a visual indication when air is exhausted from its line. The low pressure switch energizes a buzzer when system pressure falls below 60 psi.

q. Toggle Type Control Valve. Four toggle type control valves (10, 13, 14 and 17) are used to provide on-off control of air pressure. When the valves are off, a path is provided to exhaust their delivery lines.

r. Drain Control Push Valve. The drain control push valve (15) is a momentary action valve for on-off control of air pressure. When the valve is released, a path is provided to exhaust its delivery line.

s. Emergency Brake Push-Pull Control Valve. The emergency brake control valve (14) is located at the operator compartment for on-off control of air pressure to the spring brake sections of the brake chambers (23, 32, 42 and 45). When the valve is off, a path is provided to exhaust air in its delivery line. The valve is also a pressure sensitive device. At 40 psi or below, the valve automatically shuts off the air supply, causing the spring brakes to be actuated.

t. Bucket Line Control Push-Pull Air Valves. The bucket line control valve (4) provides on-off control of air pressure for bucket line operation. When the valve is off, a path is provided to exhause its delivery line.

u. Low Air Pressure Indicator. The low air pressure indicator (21) is normally held in position above the driver windshield. When system pressure drops to 60 psi, a shaft with a sign plate drops into the driver field of view to provide a warning.

v. Indicator Shutoff Valve. The indicator shutoff valve (20) provides a means of closing off the air line when the windshield is removed for shipment. This prevents entry of foreign matter into the air system.

w. Automatic Towing Hose Coupling Assembly. The two automatic coupling assemblies (26 and 30) are used to provide air pressure input for braking control when the ditcher is disabled and must be towed. The left-hand, emergency coupling pressurizes the complete system. This enables release of the emergency brakes and application of the service brakes by the ditcher driver. The right-hand, service coupling permits brake applications to be made from the towing vehicle.

x. Hose Coupling Shut-off Cock. The two hose coupling shut-off cocks (25 and 31) keep the two air lines closed when not in use. This prevents entry of foreign matter.

Section II. COMPRESSOR ASSEMBLY

9-3. Description

a. General.

(1) The compressor assembly (fig. 9-3) is a single-acting reciprocating two cylinder type with automatic inlet valves. The rated capacity of the compressor is 12 cubic feet per minute, which is based on the piston displacement in cubic feet per minute with the compressor running at a speed of 1250 rpm.

(2) The compressor air intake line is connected to the air box cover to draw filtered air supply from the left hand side of the engine. The compressor cylinder head and block are water cooled by the coolant from the engine cooling system.

(3) The compressor is lubricated by the engine lubricating oil. Oil under pressure from the engine enters the compressor through a passage in the compressor crankcase rear end cover. It is then directed to the connecting rod bearings (16) through drilled holes in the crankshaft (18). The crankshaft main bearings (20) are splash lubricated. The wrist pins (22) and bushings (21) are lubricated by oil dripping from the piston drip boss (24) into a funnel in the top of the connecting rod, allowing the oil to flow through oil holes in the bushings and wrist pins. Surplus oil returns to the engine crankcase through a hole in the compressor base plate.

(4) The compressor runs continuously while the engine is running, but the actual compression of air is controlled by the governor, which, acting in conjunction with the unloading mechanism in the compressor cylinder block body (11), starts or stops the compression of air by unloading or loading the compressor when the pressure in the air system reaches the desired minimum or maximum.

b. Compressing Air (Loaded). During the down stroke of each piston (25), a partial vacuum is created above the piston which unseats the inlet valve (5) allowing air drawn through the intake port (12) to enter the cylinder above the piston. As the piston starts the upward stroke the air pressure on top of the inlet valve, plus the force of the inlet valve return spring (4), closes the inlet valve. The air above the piston is further compressed until the pressure lifts the discharge valve (2) and the compressed air is discharged through the discharge port (6) into the reservoir. As each piston starts its down stroke, the discharge valve above it returns to its seat (3), preventing the compressed air from returning to the cylinder, and the same cycle is repeated.

c. Not Compressing Air (Unloaded). When the air pressure in the reservoir reaches the maximum setting of the governor, compressed air from the reservoir passes through the governor into the cavity below the unloader pistons (13) in the compressor cylinder block body. This air pressure lifts the unloader pistons which in turn lift the inlet valves (5) off their seats (23).

d. Passage of Air During Non-Compression. With the inlet valves held off their seats, the air during each upstroke of the piston is forced through the air inlet cavity and to the other cylinder where the piston is on the downstroke. When the air pressure in the reservoir is reduced to the minimum setting of the governor, the governor releases the air pressure beneath the unloader pistons. The unloader piston return spring (8) then forces the piston down and the inlet valve springs (4) return the inlet valves to their seats and compression is resumed.

9-4. Removal

Remove the compressor assembly (para 2-49).

9-5. Disassembly

Note. Disassembly of the compressor assembly is generally in the numerical sequence as illustrated on figure 9-4. Refer to steps *a* through *p*, below, for detailed information.

a. Before starting disassembly, remove all grease and dirt from the exterior of the compressor using cleaning solvent and a brush.

b. Mark the following items to show their proper relationships prior to disassembly.

(1) Position of cylinder block body in relation to crankcase.

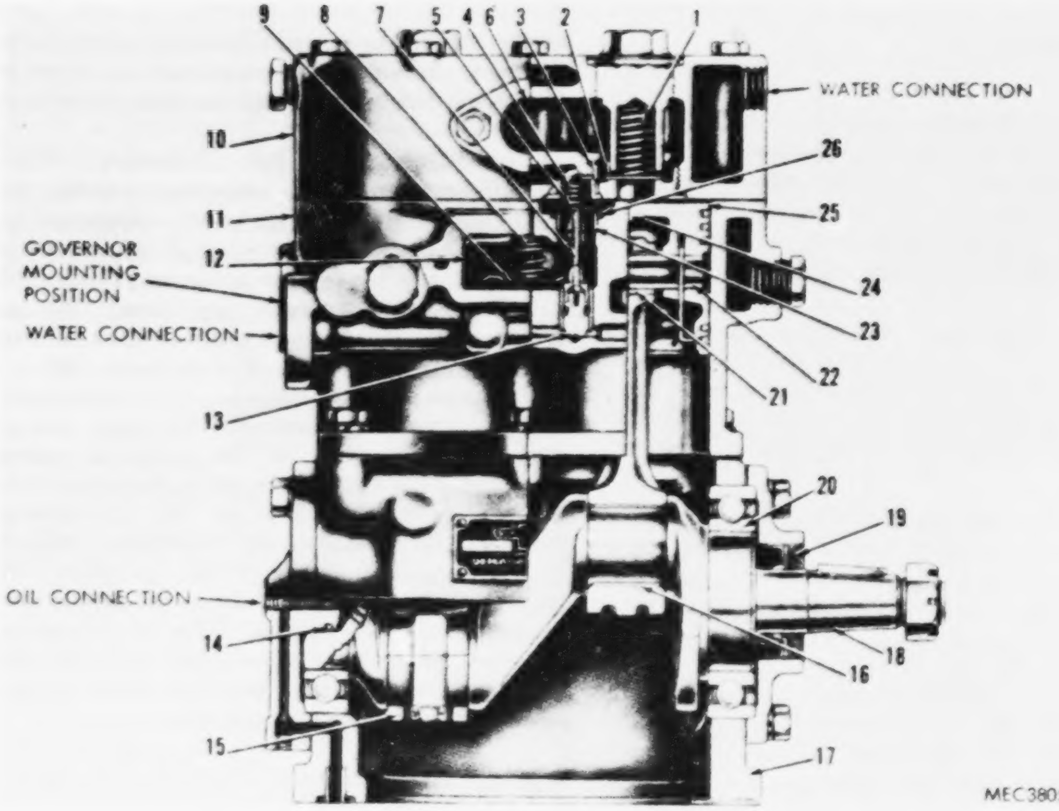
(2) Position of end covers in relation to crankcase.

(3) Position of crankshaft in relation to crankcase.

c. Remove the cap screws (1, fig. 9-4) securing the cylinder head to the cylinder block and lift off the cylinder head. The cylinder head may have to be tapped with a rawhide hammer to break the gasket joint.

d. Scrape the cylinder head gasket (13) off the cylinder head and block.

e. Remove the discharge valve cap nuts (2) and lift out the discharge valve springs (3) and



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1	Discharge valve spring	14	Preformed packing
2	Discharge valve	15	Connecting rod and cap assembly
3	Discharge valve seat	16	Insert bearing
4	Inlet valve spring	17	Crankcase
5	Inlet valve	18	Crankshaft
6	Discharge port	19	Crankshaft oil seal
7	Unloader plunger	20	Ball bearing
8	Unloader spring	21	Wrist pin bushing
9	Unloader spring saddle	22	Wrist pin
10	Cylinder head body	23	Inlet valve seat
11	Cylinder block body	24	Piston drip boss
12	Intake port	25	Piston
13	Unloader piston	26	Inlet valve guide

Figure 9-3. Compressor assembly, cutaway view.

discharge valves (4). The discharge valve seats (5) can be removed, but it is not necessary unless they are badly worn or nicked.

f. Remove the inlet valve springs (19) and inlet valves (21) from the cylinder block.

g. Remove the cap screws (36) and lock washers (37) and remove the base plate (38) and gasket (39).

h. Remove one connecting rod cap (42) and push the piston (48) with connecting rod (50) attached, out the top of the cylinder block. Replace the cap on the connecting rod. Note that the cap is punch marked to show the proper position of the cap on the rod.

i. Repeat step *h* to remove the second piston and connecting rod.

Note. The two connecting rod caps are not interchangeable.

j. Remove the piston rings (44 and 45) from each piston. If the pistons are to be removed from the connecting rods, remove the wrist pin lock wire (46) and press the wrist pin (47) out of the piston and connecting rod.

k. Remove the nut (52) securing the drive pulley (53) to the crankshaft (61) and use a gear puller to remove the pulley from the crankshaft. Remove the key (54) from the crankshaft.

l. Remove the cap screws (55) securing the front end cover (58) to the crankcase (68). Slide the front cover, with oil seal (57), off the crankshaft. Do not remove the oil seal from the cover unless it is to be replaced. Remove the cap screws (62) securing the rear cover (66) to the crankcase.

m. Press or drive the crankshaft with the ball bearings (60) out of the crankcase from the drive end of the compressor. The ball bearings can be pressed off the crankshaft if necessary to replace.

n. Remove the six cap screws (14) and lock washers (15) securing the cylinder block to the crankcase and remove the cylinder block and gasket (35).

o. Remove the unloader valve spring (16) and spring seat (18). Remove the unloader spring saddle (17), unloader plunger (24), and unloader pistons (27) with packing.

Note. It may be necessary to apply air pressure, WITH CAUTION, at the governor port of the cylinder block to remove the unloader pistons.

p. Remove the inlet valve seats (22) and piston bushings (28) only if worn or damaged.

9-6. Cleaning

a. Wash all parts in an oil solvent, and dry thoroughly with compressed air.

b. Put the cylinder head body (12, fig. 9-4) through a cleaning solution to remove all carbon from the discharge valve cavities and to remove all rust and scale from water cavities. Scrape carbon, dirt, and particles of old gaskets from all surfaces.

c. Clean thoroughly all oil passages through the crankshaft (61), connecting rods (50), crankcase (68), base plate (38), and rear end cover (66). If necessary, prod oil passages with wire and flush with cleaning solvent.

d. Put the cylinder block body (34) through a cleaning solution to remove all carbon and dirt from the inlet passages and unloader passages and to remove rust and scale from the water cavity. Scrape particles of old gaskets from all surfaces.

9-7. Inspection and Repair

a. Inspect the cylinder head body (12, fig. 9-4) for cracks and breaks. Replace if any are found.

b. Test the water jacket of the cylinder head body and cylinder block body (34) for leakage, using air pressure. Replace the part if leakage is found.

c. Check the crankcase (68), cylinder block body, and end covers (58 and 66) for cracks. Replace if any are found.

d. Check the fit of the bearings (60) in the crankcase. The bearings must be a finger press fit. If the bearing bores are worn or damaged, the crankcase should be replaced.

e. Check the fit of the unloader pistons (27) and packing in the cylinder block for excessive wear. If necessary, install new packing to make the pistons a neat sliding fit in their bores. The bores must not be scratched or damaged in any way which might accelerate packing wear.

f. Check the unloader piston return spring (16) for a permanent set. If the spring does not have sufficient tension to return the unloader pistons to the loaded position, replace the spring.

g. Inspect the inlet valves (21) and seats (22). If the valves are grooved deeper than .003 inch where they contact the seat, they should be replaced. Inlet valves not worn excessively or damaged can be reclaimed by lapping them on a piece of crocus cloth on a flat surface. If the inlet valve seats show signs of slight scratches or wear they can be reclaimed by using a lapping stone, grinding compound, lapping disc, and valve grinding tool. If the seats cannot be reclaimed in this manner, they should be replaced. The dimension from the top of the cylinder block to the inlet valve seat should not exceed .145 inch. After installing new seats, the dimension should be .101 to .113 inch.

h. Discard the old discharge valve springs (3) and replace with new springs. Inspect the discharge valves (4) and discharge valve seats (5). If the valves are not worn excessively, they can be cleaned by lapping them on a piece of crocus cloth on a flat surface. If the seats are worn excessively so there is no longer sufficient metal left to reclaim the seat by using a lapping stone, the seats should be replaced. If new discharge valves, springs, and cap nuts are installed, the discharge valve travel should be .056 to .070 inch.

i. Test the discharge valves for leakage by applying 100 pounds of air pressure through the discharge port of the cylinder head and applying soap suds to the discharge valve openings. (Fig. 9-5) Leakage in the forming of soap bubbles is permissible.

j. If excessive leakage is found, leave the air pressure applied and using a fiber or hardwood dowel and a light hammer, tap the discharge valves off their seats several times to improve

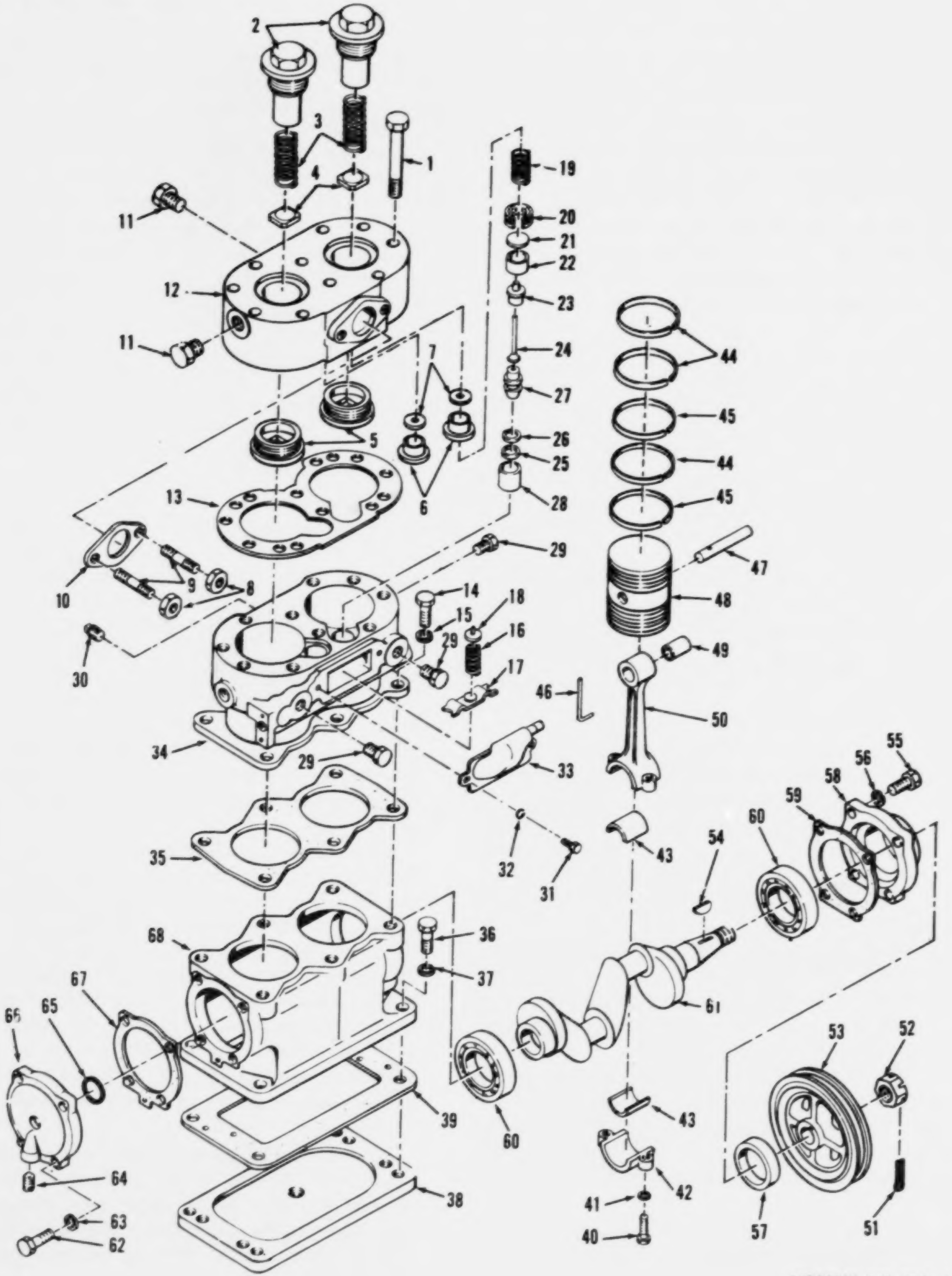
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Figure 9-4. Compressor assembly, exploded view.

1 Screw, hex cap, 5/16–18 (10 rqr)
2 Cap nut, discharge valve (2 rqr)
3 Spring, discharge valve (2 rqr)
4 Valve, discharge (2 rqr)
5 Seat, discharge valve (2 rqr)
6 Insert, inlet valve spring (2 rqr)
7 Seat, inlet valve spring (2 rqr)
8 Nut, hex, 5/16–24 (2 rqr)
9 Stud, head, 5/16–24 (2 rqr)
10 Gasket, discharge fitting
11 Plug, pipe (2 rqr)
12 Cylinder head body
13 Gasket, cylinder head
14 Screw, hex cap, 3/8–16 (6 rqr)
15 Washer, lock, 3/8 (6 rqr)
16 Spring, unloader
17 Saddle, unloader spring
18 Seat, unloader spring
19 Spring, inlet valve (2 rqr)
20 Guide, inlet valve (2 rqr)
21 Valve, inlet (2 rqr)
22 Seat, inlet valve (2 rqr)
23 Guide, unloader plunger (2 rqr)
24 Plunger, unloader (2 rqr)
25 Packing, preformed (2 rqr)
26 Ring, back-up (2 rqr)
27 Piston, unloader (2 rqr)
28 Bushing (2 rqr)
29 Plug, pipe (3 rqr)
30 Plug, pipe
31 Bolt, 5/16 x 3/4 (2 rqr)
32 Washer, lock, 5/16 (2 rqr)
33 Elbow, flanged
34 Cylinder block body
35 Gasket, cylinder block
36 Screw, cap, hex (4 rqr)
37 Washer, lock (4 rqr)
38 Plate, base
39 Gasket, flange
40 Bolt (4 rqr)
41 Washer, lock (4 rqr)
42 Cap, connecting rod (2 rqr)
43 Bearing, insert (4 rqr)
44 Piston ring, narrow (6 rqr)
45 Piston ring, wide (4 rqr)
46 Lock wire, wrist pin (2 rqr)
47 Pin wrist (2 rqr)
48 Piston (2 rqr)
49 Bushing, wrist pin (2 rqr)
50 Connecting rod (2 rqr)
51 Cotter pin
52 Nut, retaining
53 Pulley
54 Key
55 Screw, hex cap, 5/16–18 (4 rqr)
56 Washer, lock, 5/16 (4 rqr)
57 Oil seal, cranshaft
58 Cover, front end
59 Gasket, front end cover
60 Bearing, ball, annular (2 rqr)
61 Crankshaft
62 Screw, hex cap, 5/16–18 (4 rqr)
63 Washer, lock, 5/16 (4 rqr)
64 Plug, pipe
65 Packing, preformed
66 Cover, rear end
67 Gasket (rear) end cover
68 Crankcase

Figure 9–4—Continued

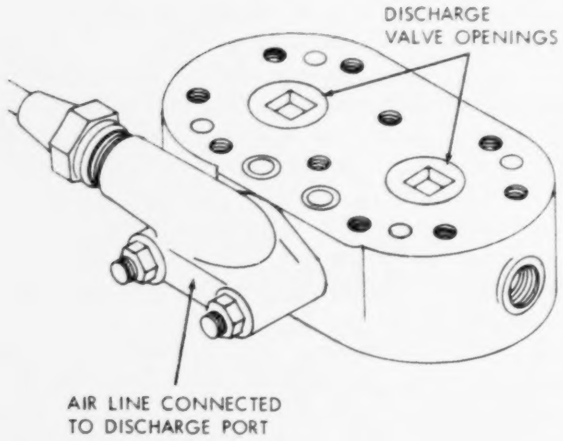

Figure 9–5. Compressor assembly discharge leakage test.

the seal between the valves and their seats. If the valves and seats have been reconditioned properly, this will reduce the leakage.

k. Leakage tests must also be made by applying soap suds around the discharge valve cap nuts with air pressure applied as above. Leakage at the cap nuts is not permissible.

l. Check the cylinder bores for evidence of excessive wear, out-of-round, and scoring. Cylinder bores which are scored or out-of-round more than .002 inch or tapered more than .003 inch should be rebored or honed oversize. Cylinder bores should be finished honed while bolted to the compressor crankcase, if possible. Cylinder bores must be smooth, straight, and round. Oversize pistons (.010, .020, and .030) are available.

m. Inspect the pistons (48, fig. 9–4) for scores, cracks, and damage of any kind. If scores or cracks are found, replace the piston.

n. Check the clearance between the pistons and the cylinder bores with feeler gage stock. (fig. 9–6) The clearance should be .002 to .004 inch.

o. Check the ring gap with the rings (44 and 45, fig. 9–4) installed in the cylinder bores. The ring gap should be .005 to .015 inch.

p. Check the pistons for correct clearance between the rings and the ring grooves. At the first, second, and fourth rings from the top of the piston, the clearance should be .002 to .004 inch. At the third and fifth rings, the clearance should be .0035 to .0055 inch.

q. Check the fit of the wrist pins (47) in the pistons and connecting rods (50). The wrist pins

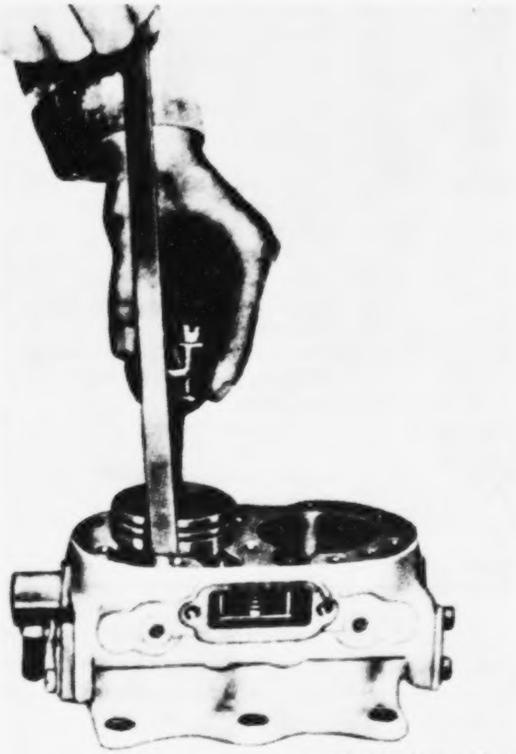

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Figure 9-6. Compressor assembly cylinder bore to piston check.

must be a light press fit in the pistons. If the wrist pin is a loose fit in the piston, the wrist pin, piston, or both must be replaced. Check the fit of the wrist pins in the connecting rod bushings (49) by rocking the pistons. Clearance of the wrist pin to the connecting rod bushing should be .001 to .006 inch. If excessive clearance is apparent, replace the bushing.

r. When pressing a new bushing in place, be sure that the oil hole in the bushing lines up with the oil hole in the connecting rod. The bushing must then be reamed, honed, or bored to provide the specified clearance between the bushing and wrist pin.

s. Inspect the connecting rod insert bearings (43) for proper fit on the crankshaft journals. If the bearings are worn, cracked, or broken, they must be replaced.

t. Crankshaft journals which are bruised or out-of-round more than .001 inch must be reground. When regrinding, the fillets at the ends of the journals must be maintained. Undersize connecting rod bearings (.010, .020, and .030) are available. Check to be sure that the oil passages are open and clean through the crankshaft.

u. The journals for the main bearings (60) must not be worn sufficiently to prevent the ball bearing from being a press fit.

v. The crankshaft grooves for the oil seal (57) must not be worn sufficiently to prevent a good fit of the oil seal. Walls of the oil seal grooves must be square and have a good finish.

w. Inspect the ball bearings for wear and flat spots. Replace the bearings if these conditions exist.

9-8. Reassembly

Note. Reassembly of the compressor assembly is generally in the reverse of the numerical sequence as illustrated on figure 9-4. Refer to steps *a* through *s* below for detailed information.

a. Place a new cylinder block gasket (35, fig. 9-4) in position on the crankcase (68). Position the cylinder block body (34) on the crankcase according to the marking made prior to disassembly. Install the cap screws (14) and lock washers (15) and tighten securely.

b. Press the ball bearings (60) on the crankshaft (61) if they were removed. Lubricate the crankshaft with engine oil and carefully insert it into the crankcase.

c. Install new packing (65) in the groove of the rear end cover (66) and lubricate the packing. Position a new gasket (67) and fasten the cover with the cap screws (62) and lock washers (63).

d. Position a new gasket (59) and fasten the front end cover (58), with oil seal (57), to the crankcase using the cap screws (55) and lock washers (56). Rotate the crankshaft to be sure it is not binding.

e. With the bushing (49) installed, position the connecting rod (50) in the piston (48) and press the wrist pin (47) into the piston with the lock wire holes in the pin aligned with the lock wire holes in the piston. (fig. 9-7).

f. Install a new wrist pin lock wire (46, fig. 9-4) in the wrist pin so that the long end extends through the piston and wrist pin. Snap the short end into the lock wire hole near the bottom of the piston skirt.

g. Install the piston rings (44 and 45) in their proper location and with the pip marks or bevel up. Stagger the piston ring gaps so that they are not in line.

h. Before installing the pistons and connecting rods, thoroughly lubricate the pistons, rings,

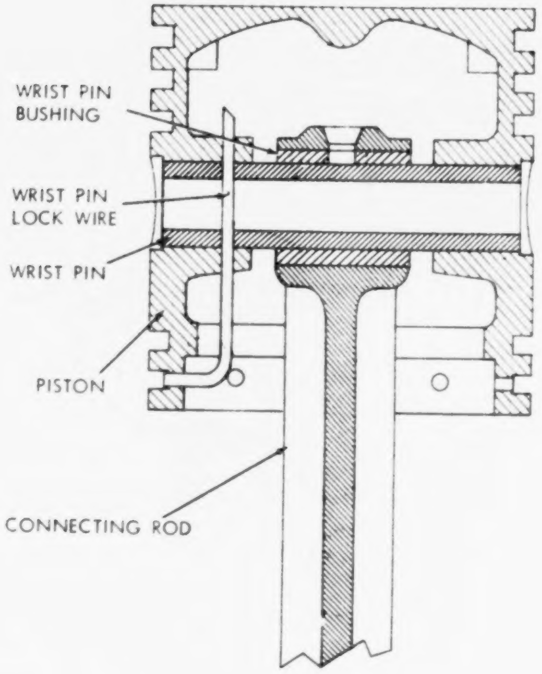


Figure 9-7. Wrist pin lock wire installation.

wrist pin bushing, and connecting rod bearings with clean engine oil.

i. Turn the crankshaft to position one crankshaft journal downward. Remove the bearing cap (42) from one connecting rod.

j. Using a ring compressor, install the connecting rod and piston through the top of the cylinder. Push the piston down until the connecting rod bearing makes contact with the crankshaft journal.

k. Install the connecting rod cap with the bearing (43) in place. Be sure that the aligning marks on the cap and rod coincide. If the cap and rod are not marked, position the cap on the rod so the two locking slots in the bearings, rod and cap are both located adjacent to the same connecting rod bolt. Secure the cap to the rod with bolts (40) and lock washers (41). Tighten the bolts evenly. Bend the lockwasher prongs up against the bolt heads.

l. Repeat steps *i*, *j*, and *k* to install the other piston and connecting rod.

m. Lubricate the unloader pistons (27), packing (25), and the unloader piston cavities with clean engine oil. Place the unloader piston packing on the unloader pistons. Install the unloader pistons, plunges (24), and guides (23) through the top of the cylinder block, taking care to avoid cutting the packing on the cylinder block.

n. Install the unloader spring saddle (17) on the unloader plungers. Install the unloader spring seat (18) in the top of the cylinder block air inlet opening. Place the unloader spring (16) between the spring seat and the spring saddle.

o. Install the inlet valve guides (20) and seats (22) in the top of the cylinder block if they were removed. Install the inlet valves (21) and inlet valve springs (19) in the cylinder block.

p. Install the discharge valves (4), springs (3) and valve cap nuts (2) in the cylinder head.

q. Place a new cylinder head gasket (13) on the block. Carefully align the inlet valve springs with the inlet valve spring inserts (6) in the cylinder head as it is placed on the cylinder block. Secure the cylinder head to the block with the cap screws (1).

r. Install the key (54) and drive pulley (53) on the crankshaft. Add and tighten the nut (52) and lock with the cotter pin (51).

s. Using a new gasket (39), install the base plate (38) with the four cap screws (36) and lock washers (37).

9-9. Testing Rebuilt Compressor

Note. In order to test a compressor under operating conditions, a test bench is necessary for properly mounting, cooling, lubricating, and driving the compressor. Tests are not compulsary if the unit has been carefully rebuilt.

a. Connect the compressor to an oil supply line capable of furnishing at least 15 psi during the test.

b. Install an oil drain line to keep the crankcase drained.

c. Install water lines for cooling to provide a minimum of 2.5 gpm of water.

d. Connect an air reservoir to the discharge port. The air reservoir volume plus the connecting line volume should be 1300 cubic inches.

e. Run the compressor at 1700-1750 rpm. The elapsed time for the compressor to build up from 0 psi to 100 psi should be a maximum of 47 seconds.

f. During the test the compressor should be checked for oil leakage and noisy operation.

9-10. Installation

Install the compressor assembly (para 2-49).

Section III. GOVERNOR

9-11. General

a. The governor operates in conjunction with the compressor unloading mechanism to automatically control the air pressure in the reservoir at 98-104 psi minimum and 118-126 psi maximum. Although the compressor operates continuously when the engine is running, actual compression of air is controlled by the governor which stops or starts compression when the desired reservoir pressure is reached. A hose is used to transmit air from the reservoir to the governor.

b. Air pressure from the reservoir acts on the piston to overcome the pressure setting spring. (fig. 9-8). The piston movement controls and inlet and exhaust valve to admit air to or exhaust air from the compressor unloading mechanism.

c. Reservoir pressure enters the governor at the port marked reservoir. As pressure increases, the piston moves against the presure setting spring (15). When the reservoir pressure reaches the cut-out setting of the governor, the piston (9) with inlet and exhaust valve (11) moves against the pressure setting spring (15). The exhaust stem (7), held stationary by the adjusting screw (3), causes the valve (11) to unseat. Air from the reservoir then flows past the valve through the horizontal passage in the piston (9) and out the port connected to the compressor unloading mechanism to stop compression. Air from the horizontal passage also flows around the piston to give added lifting force and more positive valve opening action.

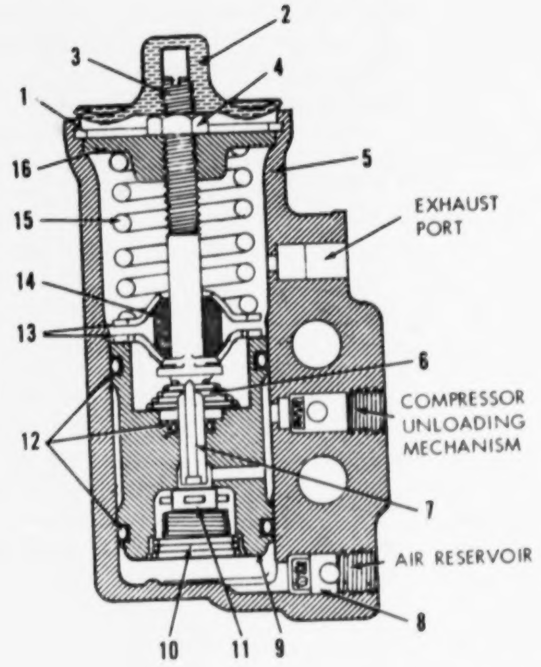
d. When the reservoir air pressure drops to the cut-in setting of the governor, the force exerted by air pressure on the piston (9) is reduced allowing the pressure setting spring (15) to return the piston, causing the valve (11) to seat. Air from the compressor unloading mechanism is then released through the piston (9) horizontal passage, up the center of the exhaust stem (7) and out the exhaust port.

9-12. Removal

Remove the governor (para 2-49).

9-13. Disassembly

Clean dirt and grease from the exterior of the governor using cleaning solvent and a brush. Disassemble the governor in the numerical sequence as illustrated on figure 9-9. Use a hooked wire to extract the packing (14) from the piston (18). Discard the packing (14 and 15) and filters (20).



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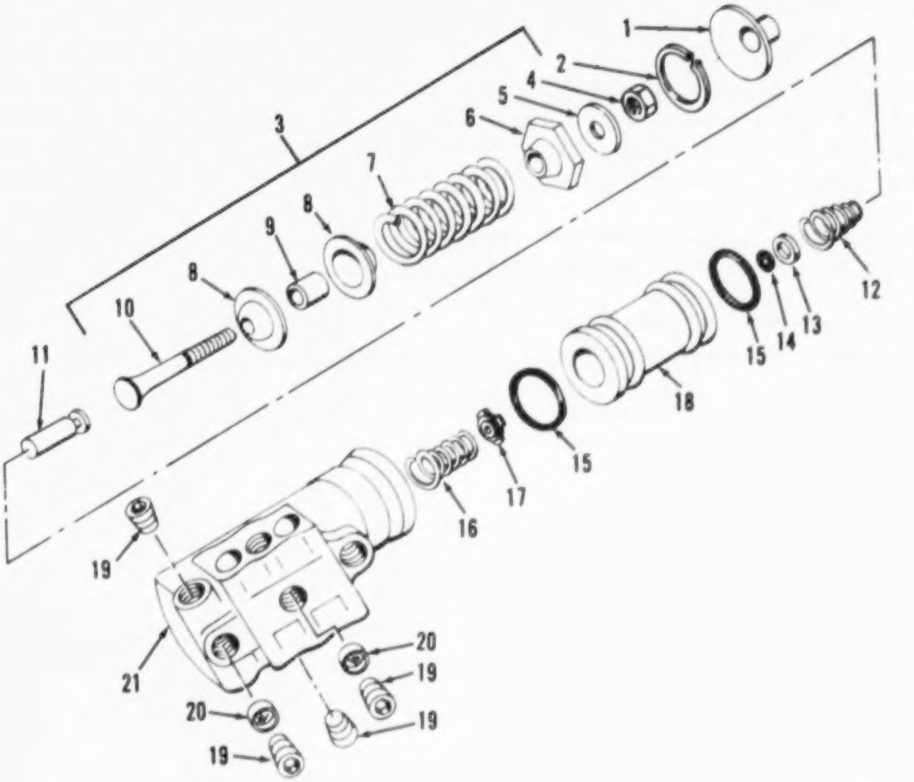
1 Retaining ring
2 Governor cover
3 Adjusting screw
4 Hex head jam nut
5 Body
6 Stem spring
7 Exhaust stem
8 Filters
9 Piston
10 Spring
11 Valve
12 Preformed packing
13 Spring lower seats
14 Spring guide
15 Spring
16 Spring upper seat

Figure 9-8. Air system governor, cross section view.

9-14. Cleaning

Clean all parts in a good cleaning solvent. Be sure that air passages in the body, exhaust stem and piston are not obstructed. Wipe rubber parts dry.



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1	Cover, governor
2	Ring, retaining
3	Adjusting screw and spring assembly
4	Nut, hex head jam, 1/4-20
5	Washer, identification
6	Seat, spring, upper
7	Spring
8	Seat, spring, lower (2 rqr)
9	Guide, spring
10	Screw, adjusting
11	Stem, exhaust
12	Spring, stem
13	Washer
14	Packing, preformed
15	Packing, preformed
16	Spring, valve
17	Valve
18	Piston
19	Plug, pipe (4 rqr)
20	Filter (2 rqr)
21	Body

Figure 9-9. Air system governor, exploded view.

9-15. Inspection and Repair

Note. Repairs to governor parts are not recommended. New parts should be used when required, expecially rubber parts.

a. Inspect the valve and the valve seats for grooves, nicks or other damage.

b. Check the fit of the exhaust stem in the piston bore. It should be a free moving fit. Check the bottom of the exhaust stem for nicks and scratches.

c. Inspect the springs for distortion, corrosion or cracks.

d. Inspect all parts for damage and excessive wear.

9-16. Reassembly

a. Lubricate the bore of the body (21, fig. 9-9), the top and all grooves of the piston (18), and the packing (14 and 15) with a barium base grease. Lubricate the spring guide (9) inside and outside surfaces with a molyblenum lubricant.

b. Install the packing (15) in the grooves of the piston.

c. Place the valve (17) in the bottom of the piston and position the valve spring (16) with the narrow end against the valve. Press the spring until the large coil end snaps into the piston.

d. Install the spring lower seats (8), spring guide (9), spring (7) and the upper spring seat (6) on the adjusting screw (10).

e. Turn the upper spring seat until an approximate dimension of 1 7/8 inches from the top of the seat to the bottom of the adjusting screw is obtained. (fig. 9-10). Install the washer (5, fig. 9-9) and the nut (4).

f. Install the packing (14) in the groove of the stem bore of the piston and cover with the washer (13).

g. Place the exhaust stem (11) into the spring (12) and insert the stem into the piston stem bore.

h. Place the adjusting screw and spring assembly (3) into the body and install the retaining ring (2) using retaining ring pliers.

i. Screw the cover (1) in place. Replace the cover if it does not seal at the body.

j. Use the head of a pencil to install new filters (20) in the front unloader and reservoir ports.

k. Install pipe plugs (19) in the front unloader and reservoir ports, the left reservoir port and the right unloader port.

9-17. Leakage Test and Adjustment

Note. A variable air pressure source and two test gages are required for this test and adjustment.

a. Connect a variable air pressure source with test gage to the reservoir port of the governor (fig. 9-8).

b. Connect a second test gage to the compressor unloading mechanism port.

c. Build up pressure until the governor cuts out (pressure indication on second test gage). Source pressure should be 110 to 115 psi.

d. If cut-out pressure is below this, remove the governor cover, loosen the lock nut, and with a screwdriver, turn the adjusting screw counterclockwise to obtain the correct cut-out pressure.

e. If the cut-out pressure is higher than desired, the adjusting screw should be turned clockwise to lower the pressure.

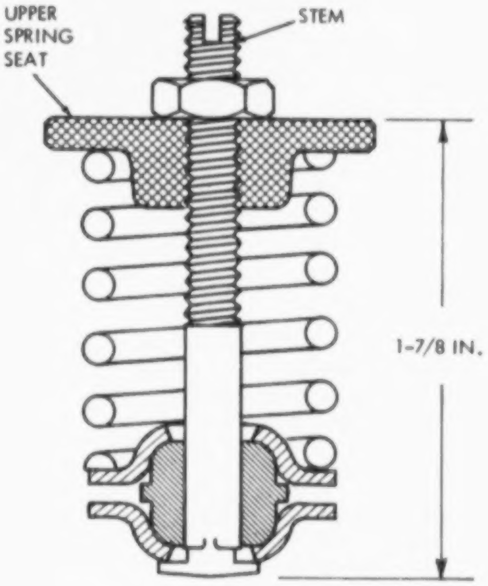
f. Be sure to tighten the lock nut and reinstall the cover when the adjustment is completed.

g. With the governor in the cut-out condition, apply soap suds at the exhaust port. Leakage indicates a defective valve, valve seat at stem bottom, stem packing, or upper piston packing.

h. With the governor in the cut-in condition, apply soap suds at the exhaust port. Leakage indicates a defective valve or bottom piston packing.

9-18. Installation

Install the governor (para 2-49).



MEC 3805-240-35/9-10

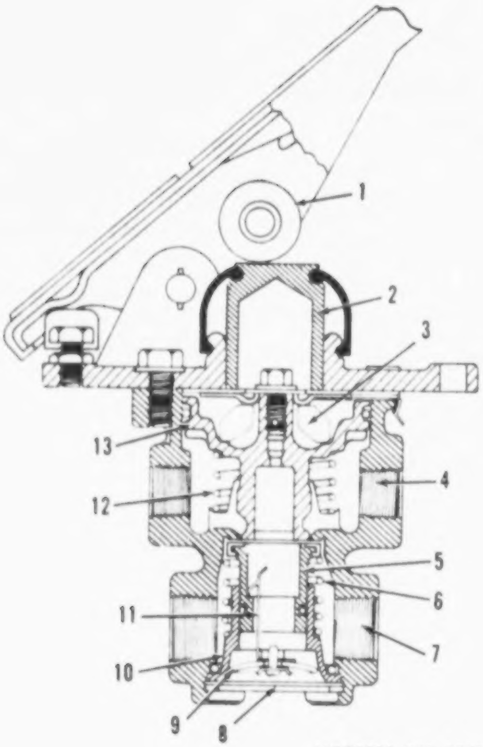
Figure 9-10. Governor adjusting screw measurement.

Section IV. BRAKE VALVE

9-19. General

a. The foot operated brake valve controls the flow of compressed air to the service sections of the brake chambers to apply or release the brakes. Movement of the foot operated lever meters the amount of compressed air used to control the degree of brake application. The valve has two optional supply ports and delivery ports. A check valve in the exhaust port prevents the entry of foreign material.

b. When the lever is depressed by foot action, mechanical force is exerted on the plunger (2, fig. 9-11), rubber spring (3), and piston (13). The downward movement of the piston closes off the exhaust and moves the inlet valve (5) off its seat. This allows air from the reservoir to flow past the inlet valve and out the delivery ports.



MEC3805-240-35/9-11

1	Headless shoulder pin
2	Detent plunge
3	Rubber spring
4	Delivery ports
5	Inlet and exhaust valve
6	Valve spring
7	Supply ports
8	Exhaust
9	Diaphragm
10	Exhaust check valve seat
11	Preload spring
12	Piston return spring
13	Piston

Figure 9–11. Brake valve, cross section view.

c. When the air pressure in the cavity beneath the piston and the compressed air being delivered to the brake chambers is equal to the mechanical force being applied with the foot lever, the piston lifts and the inlet valve closes, shutting off further flow of air through the valve. The exhaust remains closed, preventing air from leaving through the exhaust port.

d. When the lever is released, mechanical force is removed from the top of the piston. The air pressure beneath the piston lifts the piston to open the exhaust valve. The air below the piston and in the delivery lines is then exhausted.

9–20. Removal

Remove the brake valve (para 2–49).

9–21. Disassembly

a. Drive out the headless pin (1, fig. 9–12) and remove the headed pin (2) to separate the lever assembly from the mounting plate (13).

b. Remove the cotter pin (4) and headed pin (5) to separate the shoulder pin (6) from the lever (7). Remove the lever cover (3).

c. Remove the boot (10) and lift the plunger (11) out of the mounting plate. Loosen the nut (8) and unscrew the stop button (9).

d. Remove the three screws and lockwashers (12) and take off the mounting plate.

e. Depress the piston (20) to remove the retainer (14).

f. Lift out this piston assembly and return spring (21). Remove the packing (15), screw (16), special washer (17), spring seat (18), and rubber spring (19) from the piston.

g. Remove the retaining ring (22) using retaining ring pliers. Take out the identification washer (23) and the valve assembly.

h. Depress the valve assembly to unhook the preload spring (32) from the inside of the inlet and exhaust valve (27). Remove the screw (29) securing the washer (30), diaphragm (31), and preload spring.

i. Remove the packing (26 and 28) from their grooves in the inlet and exhaust valve (27) and exhaust check valve seat (33).

j. Remove the vent filter (34) from its slot in the body.

9–22. Cleaning

a. Wash all parts in a cleaning solvent. Wipe all rubber parts clean.

b. Check that air passages, packing grooves, and the vent filter slot are clear of any foreign material.

9–23. Inspection and Repair

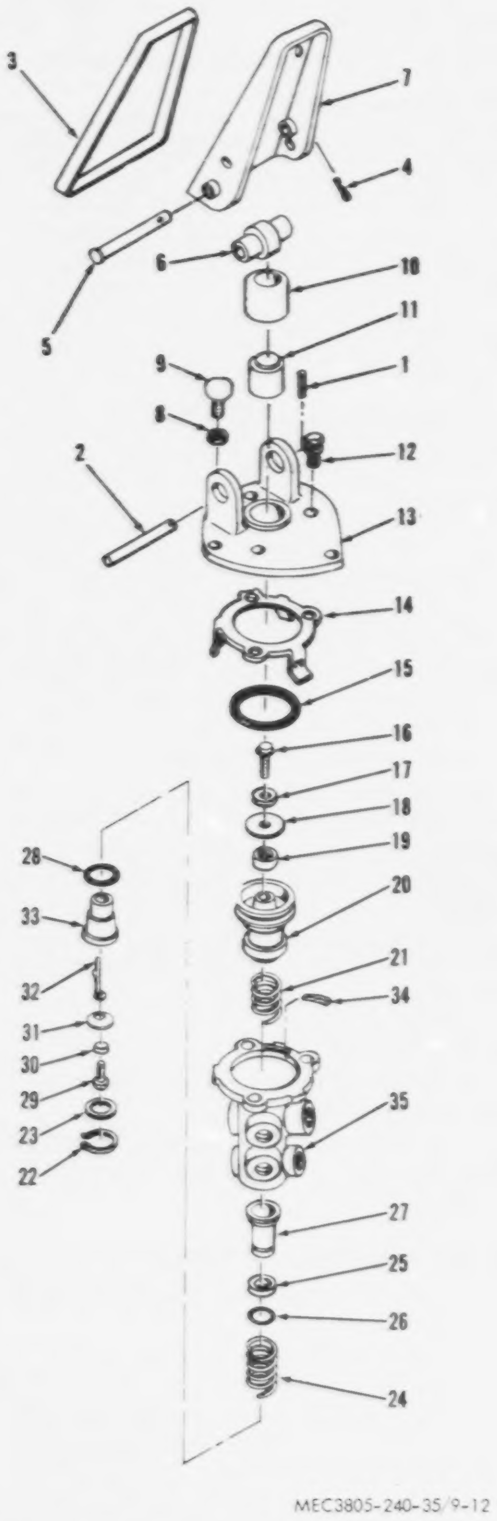
a. Inspect all parts for cracks, breaks, or other damage.

b. Inspect the valve (27, fig. 9–12) for deterioration, wear, and scratches.

c. Inspect the valve seating surfaces in the body (35) and or the bottom of the piston (20) for nicks and scratches.

d. Inspect the exhaust diaphragm (31), boot (10), and rubber spring (19) for flexibility, wear, and deterioration.

e. Check the lever cover (3) and stop button for excessive wear.



1	Pin, straight, headless
2	Pin, straight, headed

Figure 9-12. Brake valve, exploded view.

3	Cover, lever
4	Pin, cotter
5	Pin, straight, headed
6	Pin, shoulder, headless
7	Lever, manual control
8	Nut, plain hex, 5/16-18
9	Button, stop
10	Boot, dust and moisture seal
11	Plunger, detent
12	Screw, assembled washer, slotted hex head, 5/16-18 x 5/8 (3 rqr)
13	Plate, mounting
14	Retainer
15	Packing, preformed
16	Screw, self-locking, 1/4-20 x 5/8
17	Washer, special
18	Seat, spring
19	Spring, rubber
20	Piston
21	Spring, piston return
22	Ring, retaining
23	Washer, identification
24	Spring, valve
25	Retainer, valve
26	Packing, preformed
27	Valve, inlet and exhaust
28	Packing, preformed
29	Screw, cross recess, pan head, 8-32 x 3/8
30	Washer, diaphragm
31	Diaphragm
32	Spring, preload
33	Seat, exhaust check valve
34	Filter, vent
35	Body, basic brake valve

Figure 9-12—Continued

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f. Replace the packing (15, 26, and 28) and any other parts found to be defective.

9-24. Reassembly

a. Install a new felt filter (34, fig. 9-12) in the slot in the body (35).

b. Lubricate the bore of the valve seat (33) with a barium base grease. Attach the preload spring (32, diaphragm (31), and washer (30) to the seat (33) using the screw (29).

c. Install the packing (15), valve retainer (25), and spring (24) on the valve (27).

d. Insert the valve into the seat until the preload spring snaps in place on the valve shoulder.

e. Insert the valve assembly into the bottom of the body, cover with the identificaion washer (23), and install the retaining ring using retaining ring pliers.

f. Attach the rubber spring (19), seat (18), and washer (17) to the piston (20) using the screw (16). Torque the screw to 40 to 60 inch pounds.

Note. No lubricant is permitted on the rubber spring.

g. Lubricate the two piston bores in the body using a barium base grease.

h. Install the packing on the piston and insert the spring (21) and piston assembly in the body. Depress the piston assembly and snap the retainer (14) onto the body.

i. Secure the mounting plate (13) to the body using the three screws and lockwasher (12). Torque the screws to 50 to 75 inch pounds.

j. Screw the nut (8) all the way onto the stop button (9) and screw the stop button all the way into the mounting plate.

k. Apply a light coating of a molybdenum lubricant to the vertical surface of the plunger (11) and install the plunger through the hole in the mounting plate. Attach the boot (10) in the grooves of the mounting plate and plunger.

Note. Do not use an excessive amount of lubricant that might work down into the valve.

l. Coat the headed pin (5) with a molybdenum lubricant. Install the shoulder pin (6) on the lever (7) using the headed pin (5) and the cotter pin (4). Bend each leg of the cotter pin to at least a 45 degree angle. Install the lever cover (3).

m. Coat the headed pin (2) with a molybdenum lubricant and use the pin to attach the lever assembly to the mounting plate. Align the hole in the headed pin with the holes in the lever boss and drive in the headless pin (1).

n. Unscrew the stop button (9) just enough to take up play in the lever movement. Then tighten the nut (8) against the mounting plate.

9-25. Operational and Leakage Test

Note. An air pressure source and a test gage are required for this test.

a. Connect an air pressure source of 115 psi to a supply port of the valve. Connect a test gage to a delivery port. Plug the remaining ports.

b. Depress the lever to several positions between the fully released and fully applied positions. The test gage reading should vary in proportion to lever movement, between 0 psi and approximately 115 psi.

c. With the lever released, use soap suds to check for leakage at the exhaust port. No leakage is permissible.

d. With the lever fully depressed, use soap suds to check for leakage at the exhaust port and the top of the valve. No leakage is permissible.

9-26. Installation

Install the brake valve (para 2-49).

Section V. BRAKE CHAMBER

9-27. General

a. Each of the four ditcher wheels is equipped with a brake that is actuated by a brake chamber. The brake chamber actuates and releases either in the operating mode or in the packing emergency mode. The brake chamber has two air pressure ports, one for emergency brake release and the other for service brake actuation.

b. In the emergency mode, air pressure is not applied in the spring brake release chamber (15, fig. 9-13) and the brake spring (1) is allowed to expand. The force of the spring is transmitted through the pushrod and plate assembly (4) and the service brake piston rod (10) to actuate the brake. To release the emergency brake, air pressure is applied at the spring brake release port (14), forcing the spring brake piston (2) to compress the spring and release the brakes. An air seal is provided by the spring brake diaphragm (3) and the packing (6).

c. In the service mode, the brake is actuated by applying air pressure at the service brake port (13). This forces the service brake piston (8) down to extend the service brake piston rod (10). The air seal in the service brake chamber (12) is provided by the service brake diaphragm (7) and the packing (6).

9-28. Removal

Remove the brake chamber (para 2-49).

9-29. Disassembly

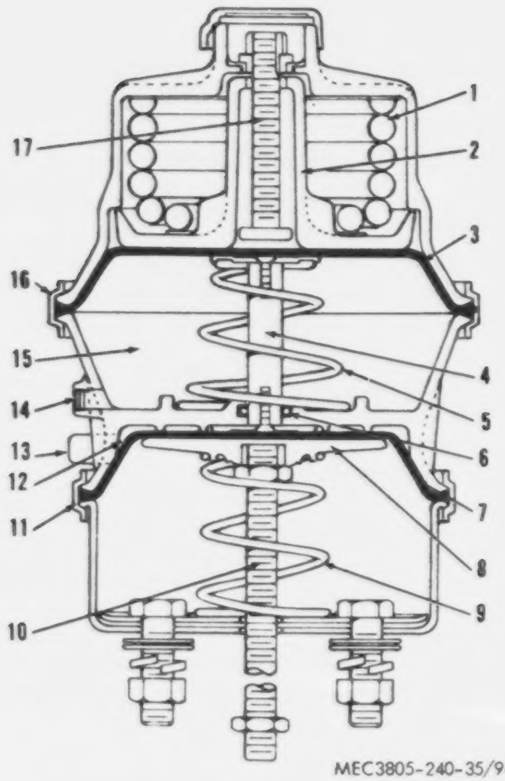
Note. A hydraulic shop press is required for complete disassembly of the brake chamber due to the tension of the brake spring (34, fig. 9-14).

a. The release bolt (31) should be unscrewed approximately 2 1/2 inches when the brake chamber is received for repair. If this has not been done, unscrew the bolt as follows:

(1) Remove the bolt (1), nut (2), and take off the breather cap (3).

(2) If available, connect 115 psi air pressure to the spring brake release port (14, fig. 9-13).

(3) Use a 3/4 inch wrench on the release nut (30, fig. 9-14) to unscrew the release bolt (31) 2 1/2 inches. Do not use impact wrench.



MEC3805-240-35/9-13

1	Brake spring
2	Spring brake piston
3	Spring brake diaphragm
4	Pushrod and plate assembly
5	Return spring
6	Preformed packing
7	Service brake diaphragm
8	Service brake piston
9	Return spring
10	Service brake piston rod
11	Bottom clamp ring
12	Service brake chamber
13	Service brake port
14	Spring brake release port
15	Spring brake release chamber
16	Top clamp ring
17	Release bolt

Figure 9-13. Brake chamber, cross section view.

b. Plug the two air ports and clean off all road dirt using cleaning solvent and a brush.

c. Remove the hex jam nut (4). Take off the nuts (8) and carriage bolts (9) to remove the bottom clamp ring (10).

d. Loosen the hex jam nut (14) and unscrew the piston rod (15) from the piston (13).

e. Place the spring brake section in a shop press using 4-inch length of 4-inch diameter tubing on the top of the spring brake section. (A, fig. 9-15).

f. Take up a very slight tension on the press.

g. Take off the nuts (17, fig. 9-14) and carriage bolts (18) to remove the top clamp ring (19).

h. Slowly relax the press and allow the ports to separate.

i. Unscrew the two flat head screws (21 and 23) to remove the pushrod plated (22 and 24) and return spring (25).

j. Pull the pushrod (26) out of the flange case (28).

k. Extract the packing (27) from the flange case using a hooked wire. Discard the packing.

l. Using a 1/8 inch punch, knock the lockpin (29) out of the release nut (30) and remove the release nut.

m. Place the head, spring and piston assembly in a hydraulic press using 4 inch and 2 inch lengths of 4 inch diameter tubing. (B, fig. 9-15) A piece of emery cloth on top of the assembly will help prevent side-slip. Be sure there is bottom access for removal of the release bolt with a screwdriver.

n. Check the alinement of the assembly in the press and take up a slight tension on the press.

o. Using a long screwdriver, unscrew the release bolt until it falls free out the bottom. The bolt is slotted on the bottom for removal. If the bolt does not turn freely, more tension will have to be applied by the press until the bolt can be turned.

9-30. Cleaning

Clean all parts in a cleaning solvent. Pay particular attention to the pushrod seal groove in the flange case

9-31. Inspection and Repair

a. Inspect all parts for cracks, damage, and excessive wear.

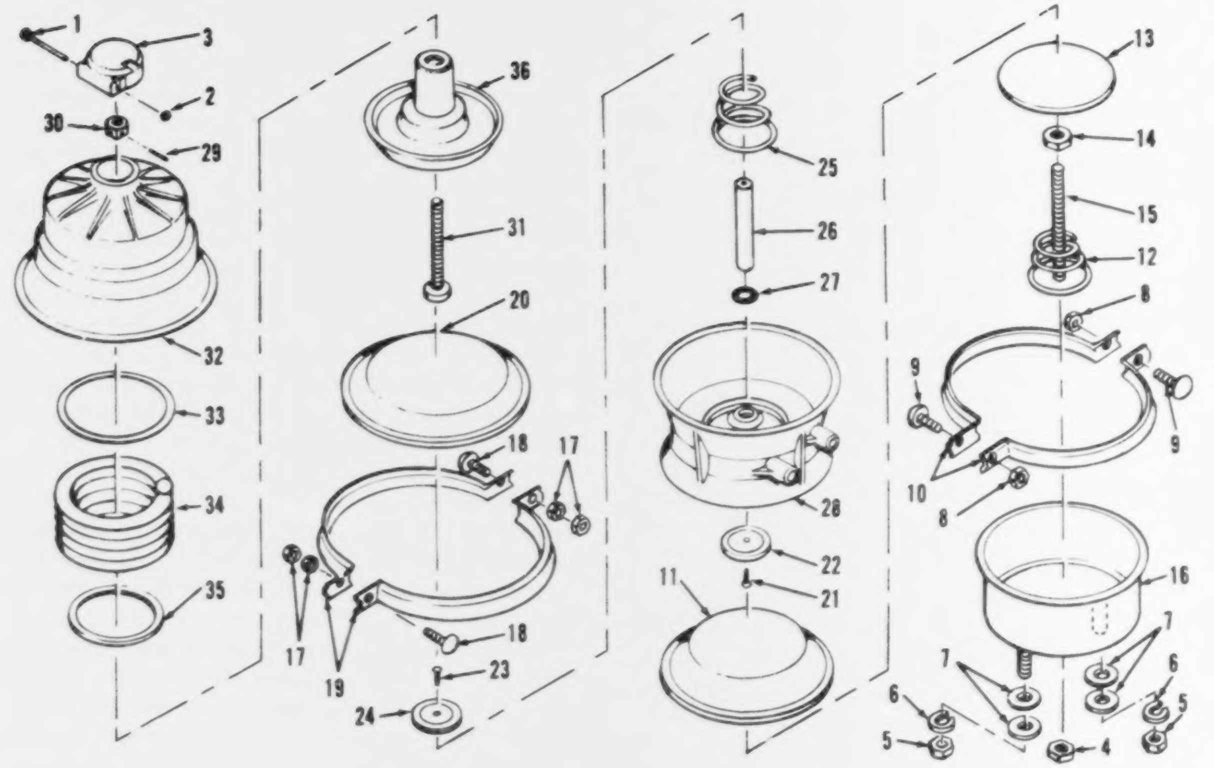
b. Check the edges of the head (32, fig. 9-14), flange case (28), and non-pressure chamber (16) for any serious deformities which might result in a poor air seal by the diaphragms.

c. Check the thrust washers (35 and 33) for excessive wear.

d. Check the pushrod (26) for scoring and scratches.

e. Replace the diaphragms (11 and 20) if there are signs of wear, cracking, or loss of resiliency.

f. The clamp rings are available only as assemblies along with their associated nuts and bolts. A new breather cap is equipped with a nut and bolt, although the nut and bolt can be obtained separately.



MEC3805-240-35/9-14

No.	Item
1	Bolt
2	Nut
3	Cap, breather
4	Nut, hex jam
5	Nut, hex jam (2 rqr)
6	Washer, lock (2 rqr)
7	Washer, flat (4 rqr)
8	Nut, hex (2 rqr)
9	Bolt, carriage (2 rqr)
10	Clamp ring, bottom
11	Diaphragm, service brake
12	Spring, return
13	Piston, service brake
14	Nut, hex jam
15	Piston rod, service brake
16	Chamber, non-pressure
17	Nut, hex (4 rqr)
18	Bolt, carriage (2 rqr)
19	Clamp ring, top
20	Diaphragm, spring brake
21	Screw, flat head
22	Plate, pushrod
23	Screw, flat head
24	Plate, pushrod
25	Spring, return
26	Pushrod
27	Packing, preformed
28	Flange case
29	Lockpin
30	Nut, release
31	Bolt, release
32	Head
33	Washer, thrust
34	Spring, brake
35	Washer, thrust
36	Piston, spring brake

Figure 9-14. Brake chamber, exploded view.

9-32. Reassembly

Note. A hydraulic shop press is required for assembly of the brake chamber to compress the brake spring (34, fig. 9-14).

a. Lubricate the pushrod (26), pushrod seal (27), release bolt (31), and the release bolt well in the spring brake piston (36) with a low temperature, moly-type lubricant.

b. Place the 2 inch long section of tubing on the hydraulic press and position the piston on the tubing. (C, fig. 9-15).

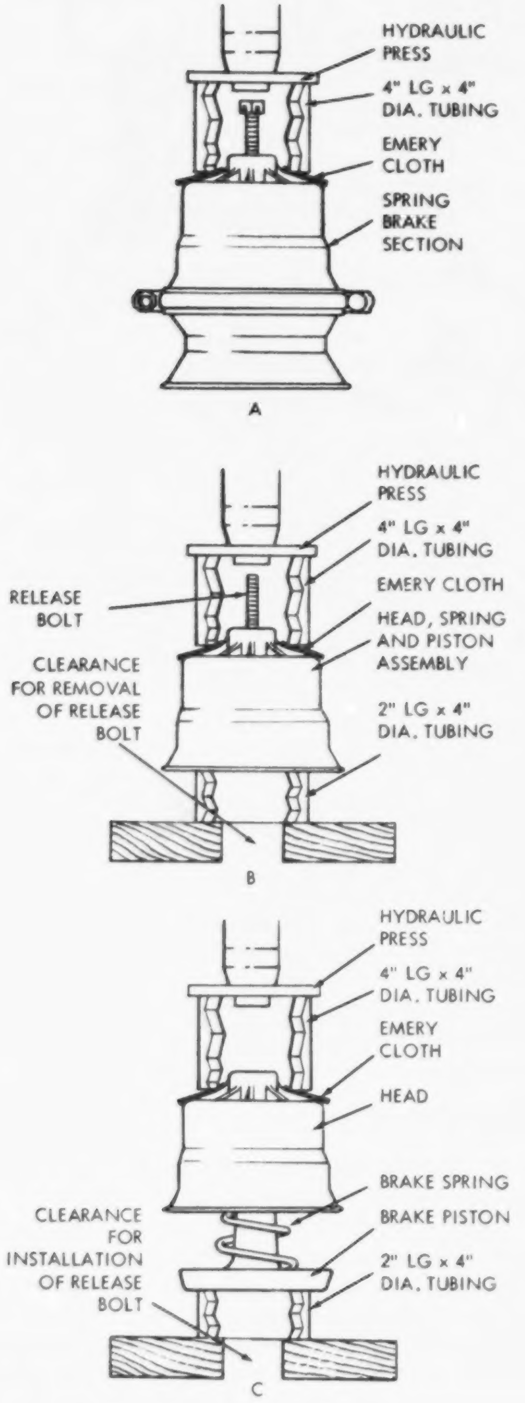
c. Place the small thrust washer on the piston and position the brake spring with the small end down.

d. Position the large thrust washer and head on the top of the spring.

e. Use emery cloth under the 4 inch long tubing to prevent side-slip. Take up a slight tension on the press. At this point the press must have 8 inches of stroke.

f. Check the alinement of the press and the assembly and slowly compress the spring, making sure the piston enters the head properly on center. It may be necessary to relax the press and realine the assembly.

g. With the spring compressed, install the release bolt from beneath and screw it in until 2 3/4 inches of the release bolt extends out the top of the head.


HYDRAULIC PRESS
4" LG x 4" DIA. TUBING
EMERY CLOTH
SPRING BRAKE SECTION
A
HYDRAULIC PRESS
4" LG x 4" DIA. TUBING
EMERY CLOTH
RELEASE BOLT
HEAD, SPRING AND PISTON ASSEMBLY
CLEARANCE FOR REMOVAL OF RELEASE BOLT
2" LG x 4" DIA. TUBING
B
HYDRAULIC PRESS
4" LG x 4" DIA. TUBING
EMERY CLOTH
HEAD
BRAKE SPRING
CLEARANCE FOR INSTALLATION OF RELEASE BOLT
BRAKE PISTON
2" LG x 4" DIA. TUBING
C

MEC3805-240-35/9-15

Figure 9-15. Disassembly and reassembly of brake chamber.

h. Relax the press slowly and remove the assembly.

i. Screw the release nut (30, fig. 9-14), with slots down, onto the release bolt. Drive the lockpin (29) through the nut slots and the bolt.

j. Install new packing (27) in the groove in the flange case (28).

k. Insert the pushrod through the seal and install the pushrod plate (22) using flat head screw (21).

l. Install the return spring (25) over the pushrod and secure it in place with the pushrod plate (24) and the flat head screw (23).

m. Place the diaphragm (20) over the flange case and position the head, spring, and piston assembly on the diaphragm.

n. Install the top clamp ring (19) with the carriage bolts (18) and nuts (17). Tap the circumference of the clamp ring to insure proper seating and re-tighten the nuts. This clamp ring has two nuts on each bolt. Be sure to install both of them.

o. Install the jam nut (14) on the piston rod (15) and screw the piston rod into the piston (13). Tighten the jam nut against the piston.

p. Position the piston assembly through the return spring (12) and into the non-pressure chamber (16). Cover with the diaphragm (11).

q. Aline the assembly with the spring brake and install the clamp ring (10) using the carriage bolts (9) and nuts (8). Tap the circumference of the clamp ring to insure proper seating and retighten the nuts.

r. The jam nut (4), flat washers (7), lockwashers (6) and jam nuts (5) can be loosely installed on the brake chamber to prevent their loss. Attach the bolt (1) and nut (2) to the breather cap (3) and keep the cap with the chamber until the chamber is installed.

9-33. Leakage Test

Note. An air pressure source of 115 psi is required for this test.

a. Apply 115 psi air pressure to the spring brake release port (14, fig. 9-13). Use soap suds to check for leakage around the top clamp ring (16).

b. Apply the air pressure to the service brake port (13). Use soap suds to check for leakage around the bottom clamp ring (11).

c. If there is any leakage, tap the circumference of the clamp ring and tighten the nuts.

9-34. Installation

Install the brake chamber (para 2-49).

Section VI. QUICK RELEASE VALVE

9-35. General

a. The quick release valve speeds up the release of air pressure from the spring brake sections of the brake chambers. When air pressure is released, the exhaust of the quick release valve opens and the air pressure accumulated in the brake chambers is exhausted through the quick release valve, allowing the spring brakes to operate.

b. When the emergency brakes are released, air pressure enters the port in the valve cover (4, fig. 9-16) and moves the diaphragm (5) down. This closes the exhaust port in the bottom of the body (6). The air pressure also bends the edges of the diaphragm down, allowing air to pass through the two side ports in the body and pressurize the brake chambers. When brake chamber pressure equals the applied pressure, the edges of the diaphragm straighten.

c. When the emergency brakes are applied and air pressure is released, brake chamber pressure on the edges of the diaphragm force the diaphragm up. This opens the exhaust port, allowing brake chamber pressure to release.

9-36. Removal

Remove the quick release valve (para 2-49).

9-37. Disassembly

Disassemble the quick release valve in the numerical sequence as illustrated on figure 9-16.

9-38. Cleaning

Clean all parts in a cleaning solvent.

9-39. Inspection and Repair

a. Inspect diaphragm (5, fig. 9-16), especially the lower part that contacts the exhaust seat, for wear and deterioration. Inspect the diaphragm for waviness, foreign material, tears, and pits.

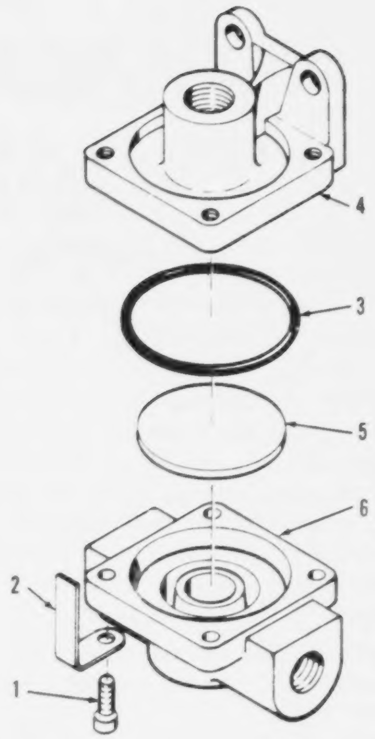
b. Inspect the cover (4) and body (6) for cracks and other damage.

c. Check the body exhaust seat for pitting and nicks. This seat should be smooth and sharp. If not, use a fine piece of emery cloth to dress the seat.

d. Replace any parts that are defective or cannot be brought up to good condition. Replace the packing (3).

9-40. Reassembly

Reassemble the quick release valve in the reverse of the numerical sequence as illustrated on figure 9-16.



MEC3805-240-35/9-16

1 Screw, socket head, 1/4-20 x 3/4 (4 rqr)
2 Tag, date
3 Packing, preformed
4 Cover
5 Diaphragm
6 Body

Figure 9-16. Quick release valve, exploded view.

9-41. Leakage Test

Note. An air pressure source of 115 psi is required for this test.

a. Apply air pressure of 115 psi to the port in the cover (4, fig. 9-16). Plug the two side ports in the body (6).

b. Use soap suds to check for leakage around the cover and at the exhaust port in the bottom of the body. Leakage at any point should not exceed a one inch soap bubble in one second. Excessive leakage indicates defective packing (3) or diaphragm (5).

9-42. Installation

Install the quick release valve (para 2-49).

Section VII. LIMITING AND QUICK RELEASE VALVE

9-43. General

a. The limiting and quick release valve provides two functions to control the operation of the front brake chamber.

(1) The limiting function of the valve permits the operator to select dry-road or slippery-road operation. In dry-road operation, the front brake chambers receive the full applied pressure. In slippery road operation, the front brake chambers receive only fifty percent of applied system pressure.

(2) The quick release function of the valve speeds up the release of air pressure from the two front brake chambers. When a brake valve application is released, the exhaust of the limiting and quick release valve opens and the air pressure accumulated in the brake chambers is exhausted through the limiting and quick release valve, rather than exhausting back through the brake valve.

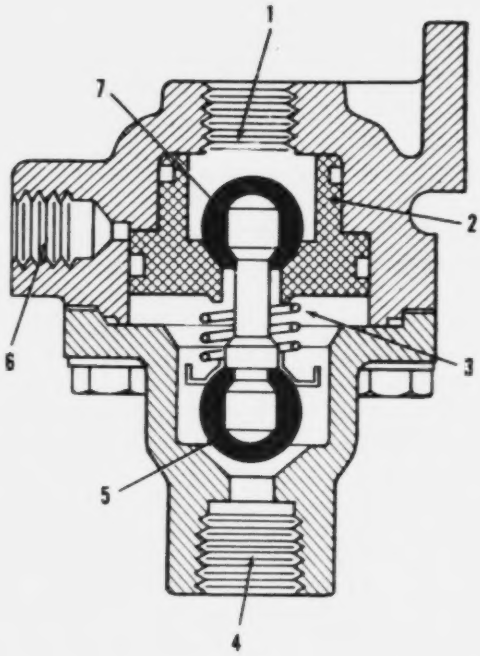
b. When a brake application is made in dry-road operation, air pressure appears at the brake valve port (1, fig. 9-17) and acts on the upper, inner surface of the piston (2). This forces the piston down, causing the exhaust valve (5) to close. The piston continues to move down, partially opening the inlet valve (7).

c. At the same time, air pressure also appears at the limiter control valve port (6). Since the piston is already partially depressed, this air pressure acts on the larger, outer surface of the piston, forcing it down to the limit of its travel. This fully opens the inlet valve, allowing full brake valve pressure to be delivered through the two side ports in the valve body.

d. When a brake valve application is made in slippery-road operation, air pressure is not applied at the limiter control valve port. The inlet valve thus remains only partially open. The air pressure building up in the brake chambers is also acting on the lower surface of the piston, which is approximately twice as large as the upper, inner surface. When the brake chamber pressure is approximately one half of the brake valve pressure, the piston moves up to close the inlet valve.

9-44. Removal

Remove the limiting and quick release valve (para 2-49).



1 Brake valve port
2 Piston
3 Valve spring
4 Exhaust port
5 Exhaust valve
6 Limiter control valve port
7 Inlet valve

Figure 9-17. Limiting and quick release valve, cross section view.

9-45. Disassembly

Disassemble the limiting and quick release valve in the numerical sequence as illustrated on figure 9-18.

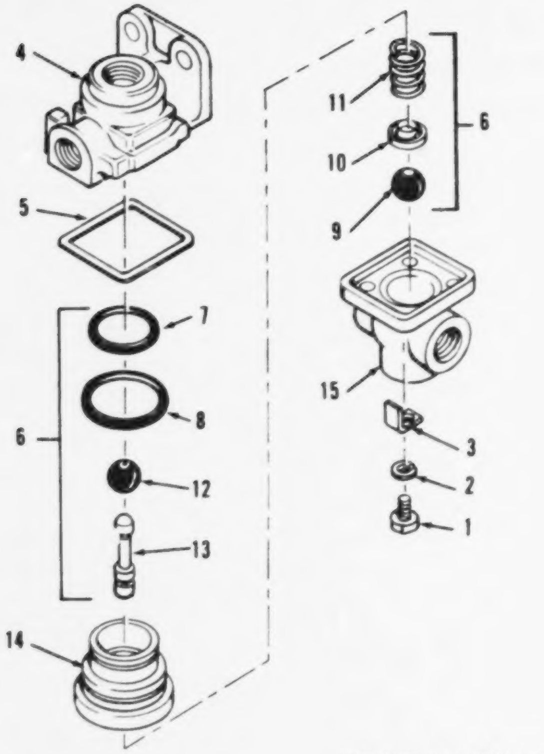
9-46. Cleaning

Wash all metal parts in a cleaning solvent. Be sure that air passages and packing grooves are clear.

9-47. Inspection and Repair

a. Examine the body (15, fig. 9-18) and cove (4) for cracks and other damage.

b. Check the exhaust valve seat in the body and the inlet valve seat in the piston (14). If a



1 Screw, hex cap, 5/16-18 x 7/8 (4 rqr)
2 Washer, lock, 5/16 (4 rqr)
3 Tag, date
4 Cover
5 Gasket
6 Valve assembly, inlet and exhaust
7 Packing, preformed
8 Packing, preformed
9 Valve, exhaust
10 Guide, valve
11 Spring, valve
12 Valve, inlet
13 Stem
14 Piston
15 Body

Figure 9-18. Limiting and quick release valve, exploded view.

seat is nicked, chipped, or worn, replace the part. Remove slight scratches or scores with crocus cloth.

c. Check the exhaust valve (9) and inlet valve (12) for wear, deterioration, pitting, and foreign material.

d. If any part of the piston (14) is heavily scratched, nicked, chipped, worn, or damaged, replace the valve assembly (6).

e. Select a new gasket (5) and new packing (7 and 8). Replace any other parts that cannot be made serviceable.

9-48. Reassembly

a. Lubricate the interior vertical surfaces of the cover (4, fig. 9-18) and the body (15) with a barium base grease.

b. Reassemble the limiting and quick release valve in the reverse of the numerical sequence as illustrated on figure 9-18.

Note. Install the cover (4) carefully so that the piston (14) is not damaged.

9-49. Operational and Leakage Test

a. Connect an air pressure source, with a test gauge, to the brake valve port (1, fig. 9-17) and to the limiter control valve port (6). Use a shutoff valve in the line to the limiter control valve port.

b. Connect a second test gage to one of the side ports in the valve body. Plug the other side port.

c. With the shutoff valve open and air pressure applied, both test gages should read the same.

d. Coat the exhaust port (4) with soap suds. Leakage should not exceed a one inch soap bubble in one second.

e. Close the shutoff valve in the line to the limiter control valve port (6). The second test gage should read approximately one half the reading of the air pressure source.

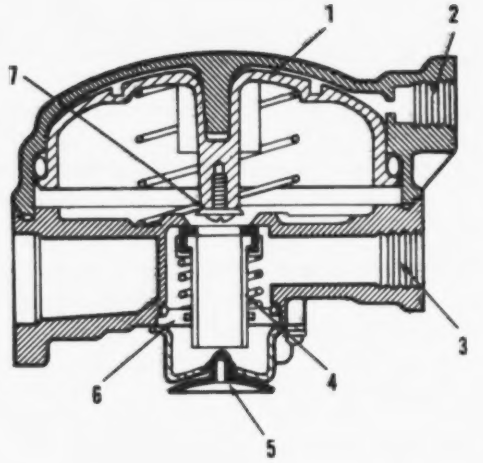
9-50. Installation

Install the limiting and quick release valve (para 2-49).

Section VIII. RELAY VALVE

9-51. General

a. The relay valve speeds up the application and release of the rear wheel brakes. It is controlled by the brake valve and keeps the air pressure in the rear brake chambers the same as the pressure being delivered by the brake valve. It reacts to even slight changes in pressure and raises, lowers, or completely exhausts the air presure in the rear brake chamber as the brake valve raises, lowers, or completely exhausts air pressure from it.



MEC3805-240-35/9-19

1	Relay piston
2	Service port
3	Supply port
4	Valve assembly
5	Exhaust check
6	Valve guide
7	Exhaust seat

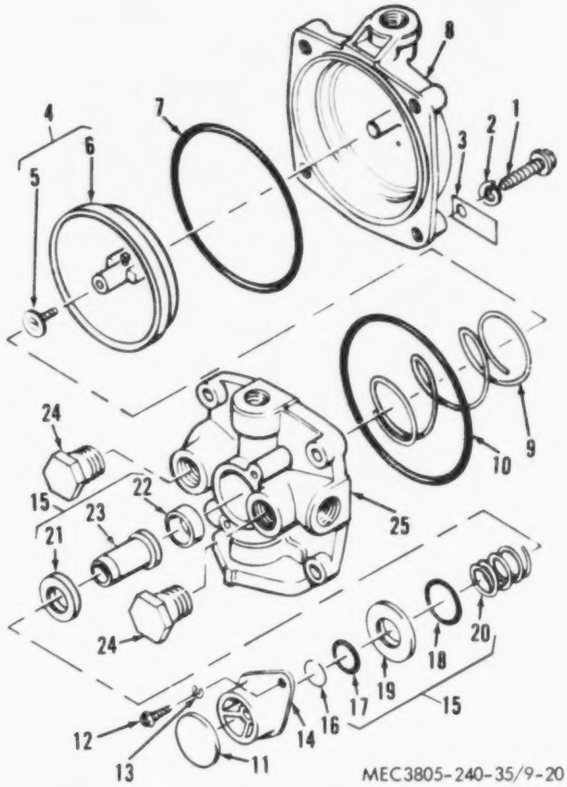
Figure 9-19. Relay valve, cross section view.

b. Air pressure from the brake valve enters the service port (2, fig. 9-19), moving the relay piston down. The exhaust seat (7) seats on the valve assembly (4), closing off the exhaust. The exhaust seat pushes the valve assembly down, unseating it from the body of the relay valve. Air from the reservoir at the supply port (3) flows past the unseated valve assembly and through the two delivery ports in the sides of the body to the brake chambers.

c. The air pressure delivered to the brake chambers also acts against the underside of the relay piston. When the brake chamber pressure equals the brake valve pressure, the valve spring causes the valve assembly to seat, cutting off delivered pressure. If the brake valve pressure is reduced or released, the pressure under the relay piston moves it up, unseating the exhaust seat. This allows brake chamber pressure to escape past the exhaust check (5).

9-52. Removal

Remove the relay valve (para 2-49).



MEC3805-240-35/9-20

1	Screw, hex head, 5/16-18 x 7/8 (4 rqr)
2	Washer, lock, split, 5/16 (4 rqr)
3	Tag, date
4	Piston assembly, relay
5	Seat, exhaust
6	Piston, relay
7	Packing, preformed, relay piston
8	Cover
9	Spring, piston return
10	Packing preformed
11	Check, exhaust
12	Screw, machine, 10-24 x 1/2 (2 rqr)
13	Washer, lock, No. 10 (2 rqr)
14	Cover, exhaust
15	Valve assembly
16	Ring, retaining
17	Packing, preformed
18	Packing, preformed
19	Guide, valve
20	Spring, valve
21	Retainer, valve
22	Valve, inlet and exhaust
23	Body, valve
24	Plug, pipe (2 rqr)
25	Body, valve

Figure 9-20. Relay valve, exploded view.

9-53. Disassembly

a. Clean off road dirt from the exterior of the relay valve using cleaning solvent and a brush.

b. Disassemble the relay valve in the numerical sequence as illustrated on figure 9-20.

9-54. Cleaning

a. Wash all metal parts in a cleaning solvent.

b. Be sure that all air passages are clear.

c. Scrape out the groove in the valve guide (19, fig. 9-20) to be sure it is clean.

9-55. Inspection and Repair

a. Inspect all metal parts for cracks or other damage.

b. Replace all packing with new parts.

c. Check the fit of the relay piston (6, fig. 9-20) in the cover (8). It must be a free sliding fit.

d. Inspect the seat for the inlet and exhaust valve (22) in body (25). Light scratches can be corrected using crocus cloth.

e. Inspect the exhaust seat (5). Replace it if it is scratched or nicked.

f. Inspect the inlet and exhaust valve (22) for pits, scratches, wear, and foreign material. Replace it if necessary.

g. Replace the exhaust check (11) if it is excessively worn, deteriorated, or stiff.

9-56. Reassembly

a. Lubricate all packing with a barium base grease.

b. Lubricate the bore in the top of the relay piston (6, fig. 9-20) with a molybdenum lubricant.

c. Reassemble the relay valve in the reverse of the numerical sequence as illustrated on figure 9-20.

9-57. Operational and Leakage Test

Note. If facilities are available, the relay valve should be tested on a suitable test rack.

a. Connect an air pressure source to the supply port (3, fig. 9-19).

b. Connect a variable air pressure source, with a test gage, to the service port (2).

c. Connect a test gage to one delivery port and plug the other delivery port.

d. Vary the air pressure at the service port. The air pressure at the delivery port should read the same as at the service port within 3 psi.

e. With pressure applied, check for leakage using soap suds. Leakage should not exceed a one inch soap bubble in one second at any point.

f. Release the pressure at the service port and note that the valve quickly exhausts through the exhaust check (5).

9-58. Installation

Install the relay valve (para 2-49).

Section IX. POWER CLUSTER ASSEMBLY

9-59. General

a. This section covers the two power cluster assemblies that are used on the ditcher. Both assemblies are identical except for the position of the mounting bracket, which can be positioned for left hand or right hand mounting.

b. The power cluster assembly is used to effect the transition from moderately applied air pressures to the relatively high hydraulic pressures required in the transfer case. This hydraulic pressure operates clutches to provide bucket line operation and differential lock-up.

c. When air pressure is applied, air enters the air cylinder (10, fig. 9-21), forcing the rod and piston assembly (1) to stroke the attached hydraulic master cylinder piston assembly (9). Hydraulic pressure is then developed to actuate the clutch in the transfer case. When the air pressure is released, air is exhausted from the cylinder and both pistons are returned by the springs (7 and 11). This reduces the hydraulic pressure.

9-60. Removal

Remove the power cluster assembly (para 2-49).

9-61. Disassembly

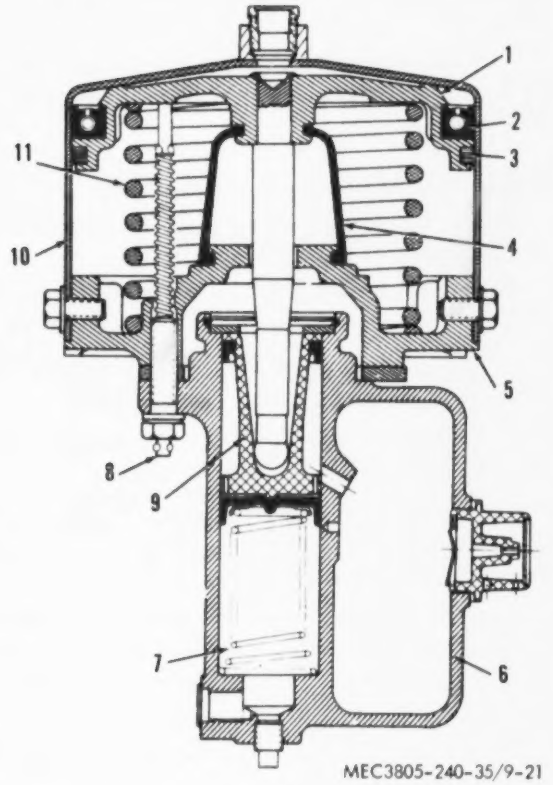
Note. Power cluster disassembly is generally in the numerical sequence as illustrated on figure 9-22. Detailed instructions are provided in steps *a* through *f*, below.

a. Clean the exterior of the power cluster using cleaning solvent and a brush. See that the hydraulic fluid has been drained out.

b. Mark the cylinder head (20) and the bracket (23) to show the proper position of the bracket for reassembly.

c. Remove the two hex head screws (4) and the stroke indicator assembly (6) to separate the air cylinder assembly and hydraulic master cylinder assembly.

d. Remove the eight hex head screws and lockwashers (9) and remove the cylinder (10) and



MEC3805-240-35/9-21

1 Rod and piston assembly
2 Piston cup assembly
3 Preformed felt
4 Boot
5 Cylinder head
6 Master cylinder and supply tank
7 Spring
8 Stroke indicator assembly
9 Piston assembly
10 Cylinder
11 Spring

Figure 9–21. Power cluster assembly, cross section view.

the rod and piston assembly (15) and associated parts.

e. From the interior side of the cylinder head (20), push out the filter (18) and associated parts using a wooden dowel.

f. Take out the retaining ring (27) and remove the remaining parts from the master cylinder tank (35).

9–62. Cleaning

a. Wash all parts in clean alcohol. Be sure that ports and the holes in the filler cap are clean and open.

b. Clean the compensating port (the smaller of the two holes in the bottom of the fluid reservoir as seen through the filler opening) by inserting a wire through it into the bore.

9–63. Inspection and Repair

a. Examine all parts for breaks, cracks, dents, and signs of excessive wear.

b. Inspect the piston cup (12, fig. 9–22), felt (13), boot (14), cup (29), and cup (31) for cracks, wear, and deterioration.

c. Check the rod and piston assembly (15) for any looseness. The joint between the rod and the piston should be air tight.

d. Inspect the master cylinder tank (35) to be sure that the bore is smooth. The bore can be smoothed with steel wool wrapped around a wool dowel. Clean the body after smoothing.

e. Select a new filler cap gasket (34) and any other necessary parts. Complete assemblies are available as follows:

(1) Air cylinder assembly (4 through 20, fig. 9–22).

(2) Piston cup assembly (11 and 12).

(3) Cylinder head assembly (17 through 20).

(4) Master cylinder assembly (27 through 35).

(5) Piston assembly (29 and 30).

9–64. Reassembly

Note. Before reassembly, dip the parts of the master cylinder assembly in a mineral oil base hydraulic fluid.

a. Position the cup (31, fig. 9–22) over the small end of the spring (32) and insert the parts into the bore of the master cylinder tank (35).

b. Install the cup (29) on the piston (30) and insert into the bore of the tank.

c. Position the thrust washer (28) and press in with a dowel enough to install the retaining ring (27) in the groove of the body.

d. Install the spring (11) in the groove in the cup (12).

e. Lubricate the cup and the felt (13) with clean engine oil and install these parts on the rod and piston assembly (15).

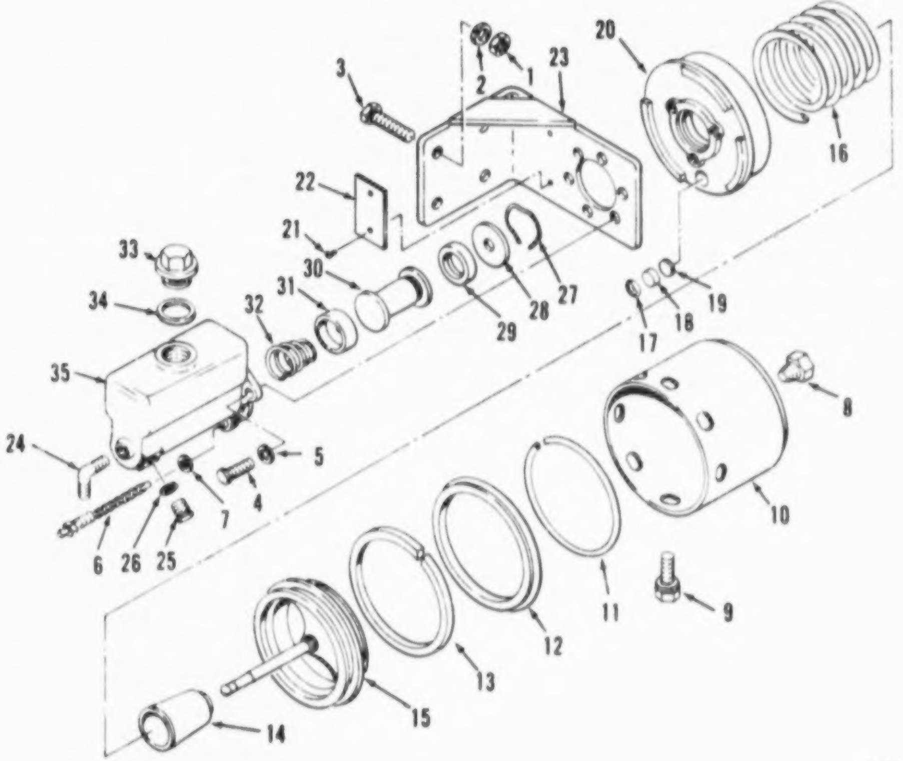
f. Place the small end of the boot (14) over the lip of the rod and piston assembly.

g. Insert the rod and piston assembly through the spring (16) and head (20), and work the end of the boot over the lip of the head.

h. Position the cylinder (10) with the screw holes in the cylinder alined with the screw holes in the head. Secure with the eight screws and lockwashers (9).

i. Position the bracket (23) against the head according to the marking made during disassembly.

j. Attach the assembled master cylinder to the bracket and head with the two hex head screws



1	Nut, plain, hex, 3/8-24 (4 rqr)	19	Screen head, filter
2	Washer, lock, 3/8 (4 rqr)	20	Head, cylinder
3	Screw, cap, hex head, 3/8-24 x 1 (4 rqr)	21	Screw, drive, No. 4 x 1/8
4	Screw cap, hex head (2 rqr)	22	Plate, identification
5	Washer, lock, 3/8 (2 rqr)	23	Bracket, angle
6	Indicator assembly, stroke	24	Adapter, tubing
7	Washer, lock, 3/8	25	Plug, pipe (2 rqr)
8	Bushing, reducer	26	Gasket, copper (2 rqr)
9	Screw, assembled (8 rqr)	27	Ring, retaining
10	Cylinder, piston and rod	28	Washer, thrust
11	Spring	29	Cup, compression
12	Cup	30	Piston
13	Felt, mechanical, preformed	31	Cup, compression
14	Boot, power cylinder	32	Spring, helical
15	Rod and piston assembly	33	Cap, filler
16	Spring, helical	34	Gasket
17	Retainer	35	Master cylinder and supply tank
18	Filter		

Figure 9-22. Power cluster assembly, exploded view.

(4) in the two side mounting holes in the master cylinder tank (35).

k. Screw the strike indicator assembly (6) in the bottom mounting hole in the master cylinder tank. Pull the stroke indicator assembly out and allow it to snap back to be sure it is not bending.

l. If a new air cylinder assembly has been used, remove the shipping protector from the front of the shell and install the reducer bushing (8) which is packed loose.

m. If a new master cylinder assembly has been used, remove the pipe plug from the end port and install the tubing adapter (24).

Loosely install the four screws (3), lock washers (2), and nuts (1) on the bracket (23) to prevent their loss.

9-65. Leakage Test

Note. An air pressure source of 50 psi and a mineral oil base hydraulic fluid are required for this test.

a. Plug the delivery port of the master cylinder tank (35, fig. 9-22).

***Caution:* Use only a mineral oil base hydraulic fluid.**

b. Carefully fill the master cylinder through the filler opening. Wipe up any spillage.

c. Connect an air pressure source of 50 psi to the fitting on the end of the cylinder (10).

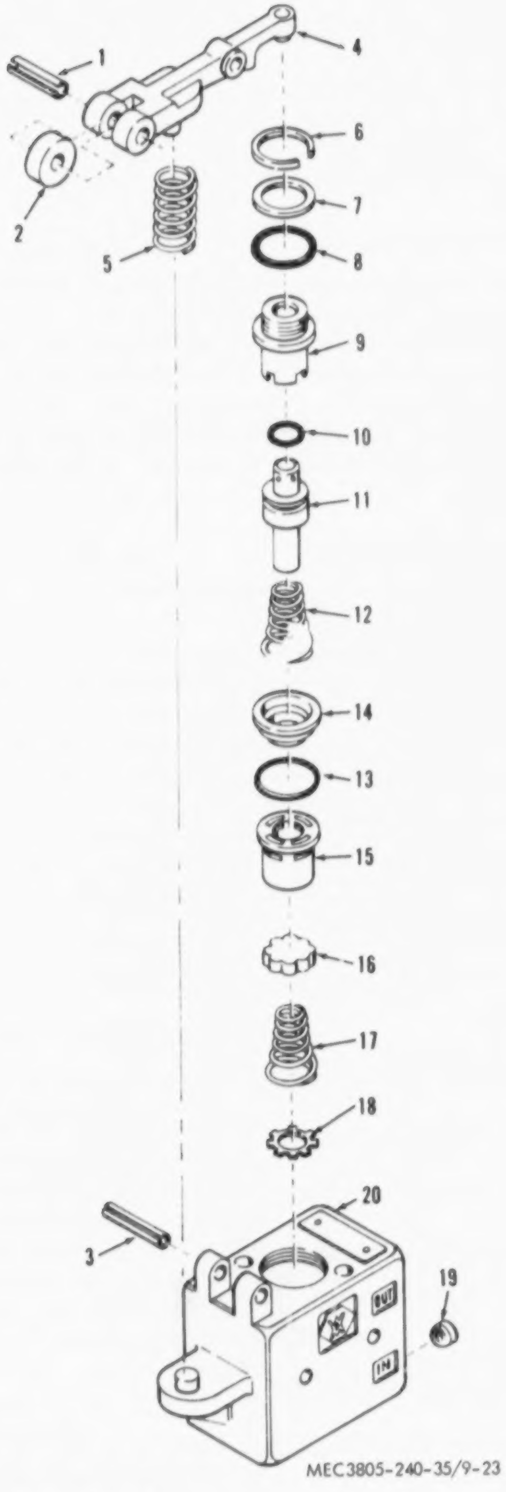
d. Examine for evidence of fluid leakage around the master cylinder tank. Leakage at the air cylinder end indicates a faulty cup (29).

e. Use soap suds to check for air leakage at the filter in the cylinder head (20). Leakage should not exceed a one inch soap bubble in one second. Excessive leakage indicates a defective cup (12).

f. Unplug the delivery port and drain the master cylinder.

9-66. Installation

Install the power cluster assembly (para 2-49).


1
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3
19
OUT
IN
MEC3805-240-35/9-23

1 Pin, roll, 1/4 x 5/8
2 Roller

Figure 9-23. Pilot air valve, exploded view.

3 Pin, roll, 1/4 x 1
4 Lever
5 Spring
6 Ring, retaining
7 Washer
8 Packing, preformed
9 Guide, plunger
10 Packing, preformed
11 Plunger
12 Spring
13 Packing, preformed
14 Seat, inlet valve
15 Spacer, valve
16 Valve, inlet
17 Spring
18 Ring, retaining
19 Strainer, inlet
20 Body, basic valve

Figure 9-23—Continued

Section X. PILOT AIR VALVE

9-67. General

a. The pilot air valve is used in the air line going to the bucket line power cluster. During operation in 4th, 5th, or 6th gear, the valve is closed preventing the bucket line from operating.

b. In the normal position, the lever return spring (5, fig. 9-23) keeps the plunger (11) depressed. This holds the valve (16) off its seat (14). This allows supply air pressure at the lower port of the body (20) to pass through to the upper port. The valve exhaust, which is through the hollow plunger, is sealed off due to the pressure of the plunger against the valve.

c. When the roller end of the lever (4) is depressed, the exhaust valve spring raises the plunger off the valve. This permits the inlet valve spring (17) to seat the valve and close off the air supply. This also enables air in the delivery line and power cluster to exhaust through the hollow stem.

9-68. Removal

Remove the pilot air valve (para 2-49).

9-69. Disassembly

Disassemble the pilot air valve in the numerical sequence as illustrated on figure 9-23.

9-70. Cleaning

a. Wash all parts in a cleaning solvent.

b. Use a wire to be sure that the hollow plunger is clear.

c. Scrape out packing grooves in the plunger guide (9, fig. 9-23), plunger (11), and inlet valve seat (14), if necessary, to remove all foreign material.

9-71. Inspection and Repair

a. Inspect all parts for cracks, breaks, excessive wear, grooving, and other damage.

b. Inspect the valve (16, fig. 9-23) for scratches, wear and deterioration.

c. Check the spring (5, 12, and 17) for loss of tension.

d. Check the valve seat (14) and the bottom of the plunger for nicks and scratches.

e. Replace the packing (8, 10, and 13) and any other parts that are found defective.

9-72. Reassembly

a. Lubricate the packing (8, 10, and 13, fig. 9-23) with a barium base grease.

b. Apply a thin coat of molybdenum lubricant to the roll pins (1 and 3), lever (4), springs (5 and 12), and the valve spacer (15).

c. Reassemble the pilot air valve in the reverse of the numerical sequence as illustrated on figure 9-23.

9-73. Leakage Test

Note. An air pressure source of 15 psi is required for this test.

a. Connect an air pressure source of 15 psi to the "in" port of the valve. Plug the "out" port.

b. With the lever (4, fig. 9-23) in the normal position, use soap suds to check for leakage at the holes in the plunger (11) and at the top of the valve body (20). Leakage at any point should not exceed a one inch soap bubble in one second. Excess leakage at the plunger holes indicates a defective valve (16). Other excess leakage around the plunger indicates defective packing (8 or 10).

c. Dry off the top of the valve before proceeding.

d. Fix the lever in a depressed position and unplug the "out" port.

e. Use soap suds to check for leakage at the "out" port. Leakage should not exceed a one inch soap bubble in one second. Excess leakage indicates a defective valve (16) or packing (13).

9-74. Installation

Install the pilot air valve (para 2-49).

Section XI. DIFFERENTIAL LOCK-UP FLUID PRESSURE REGULATING VALVE ASSEMBLY

9-75. General

a. The fluid pressure regulating valve assembly provides a protected air brake system. When system air pressure exceeds 60 psi, the regulating valve allows air flow for operation of a power cluster, which in turn operates a clutch in the transfer case to provide differential lock-up. If system pressure drops below 60 psi, the regulating valve cuts off flow to the power cluster, conserving air pressure for the brakes.

b. Reservoir air pressure, connected to the front port of the body (7, fig. 9-24), is present in the body cavity below the diaphragm. If reservoir pressure is greater than the pressure of the spring (16), the diaphragm is raised, holding the valve (14) off its seat (6). This allows air to pass through the exhaust port in the bottom of the body. If reservoir pressure drops below 60 psi, the pressure of the spring keeps the valve seated, preventing any appreciable air flow through the exhaust port.

c. The pressure setting of the spring is made with the adjusting screw (18). The dampener (15) rides against the inside of the cover (20) to minimize the effect of transient air pressure variations. This provides smoother operation of the spring to prevent rapid opening and closing of the valve when other components of the air system are operated.

9-76. Removal

a. Exhaust air system pressure (para 2-49).

b. Refer to figure 9-25 for the regulating valve location.

c. Tag and disconnect the four air lines.

d. Remove the two mounting hex nuts, lock washers, and cap screws.

e. Unscrew the two tees.

9-77. Disassembly

Disassemble the regulating valve in the numerical sequence as illustrated on figure 9-24.

9-78. Cleaning

Wash all parts in a cleaning solvent.

9-79. Inspection and Repair

a. Inspect all parts for cracks, breaks, and excessive wear.

b. Examine the diaphragm (11, fig. 9-24) for holes, deterioration, and stiffness.

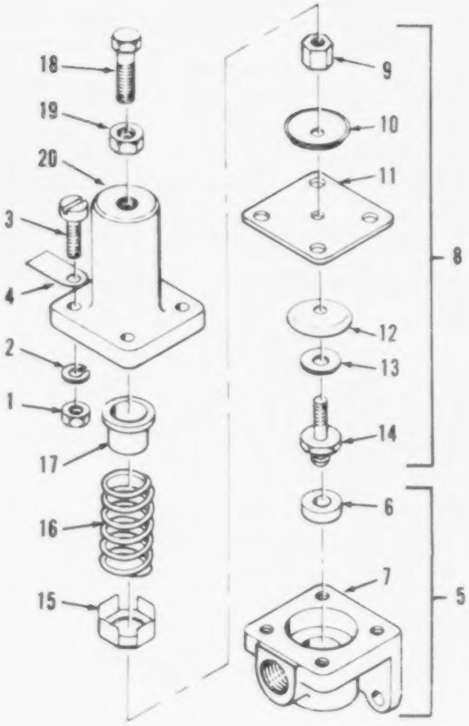
c. Inspect the valve (14) and seat (6) for pits, scratches, and foreign material.

d. Check that the air passages in the body (7) and the vent hole in the cover (20) are clear of any foreign material.

e. With the spring (16) and spring seat (17) in place, check the fit of the dampener (15) in the cover (20). It should restrict the spring movement.

9-80. Reassembly

Reassemble the regulating valve in the reverse of the numerical sequence as illustrated on figure 9-24.



MEC3805-240-35/9-24

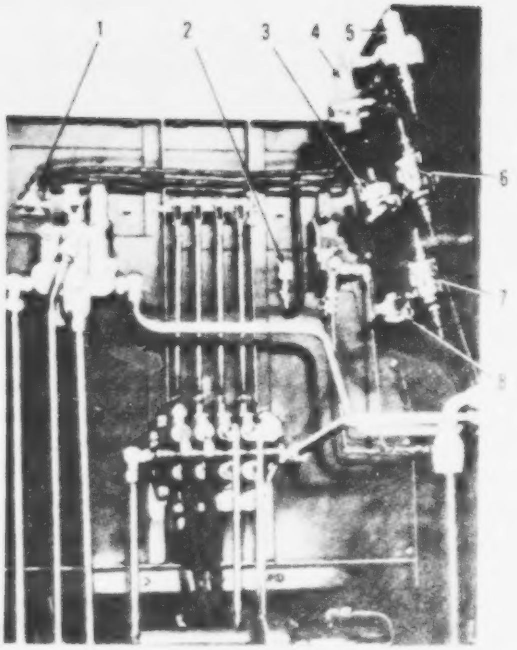
1	Nut, hex, 1/4-20 (4 rqr)
2	Washer, lock, 1/4 (4 rqr)
3	Screw, machine, fillister head, 1/4-20 x 7/8 (4 rqr)
4	Tag, date
5	Body, assembly
6	Seat, valve
7	Body
8	Diaphragm assembly
9	Nut, stem lock, 8-32
10	Follower (upper)
11	Diaphragm
12	Follower (lower)
13	Shim, fabric
14	Valve
15	Dampener
16	Spring
17	Seat, spring
18	Screw, adjusting, 1/4-20 x 1 1/4
19	Nut, lock, 1/4-20
20	Cover

Figure 9-24. Differential lock-up fluid pressure regulating valve assembly, exploded view.

9-81. Test and Adjustment

Note. A variable air pressure source and an accurate test gage are required for this test and adjustment.

a. Connect a variable air pressure source and an accurate test gauge to the front port of the body (7, fig. 9-24).



MEC3805-240-35/9-25

Figure 9-25. Air system components behind operator compartment.

1 Differential lock-up toggle type control valve
2 Bucket line control push-pull air valve
3 Differential lock-up pressure switch
4 Bucket line air regulator assembly
5 Differential lock-up fluid pressure regulating valve assembly
6 Differential lock-up double check valve
7 Emergency brake double check valve
8 Emergency brake pressure switch

Figure 9-25—Continued

b. Adjust the air pressure to 115 psi. Use soap suds to check for leakage at the vent hole in the cover (20) and between the cover and body. Any leakage indicates a defective diaphragm.

c. Adjust the air pressure to 60 psi. Loosen the lock nut (19) and turn the adjusting screw (18) until air flow out the bottom port just stops.

d. Raise and lower the pressure several times and check that the valve closes at 55 to 65 psi. Readjust if necessary and tighten the lock nut.

e. Reduce the air pressure to 10 psi below the setting. Use soap suds to check for leakage at the exhaust port. Leakage in excess of a one inch soap bubble in one second indicates a defective valve or valve seat.

9-82. Installation

Refer to figure 9-25 and install the regulating valve in the reverse of the removal procedures.

Section XII. BUCKET LINE AIR REGULATOR ASSEMBLY

9-83. General

a. The bucket line air regulator assembly is designed to provide regulated air pressures up to 50 psi. In the bucket line circuit, the regulator is adjusted to 15 ± 1 psi to meet the needs of the bucket line power cluster. This adjustment is critical in that pressure supplied by the power cluster must be just enough to keep the associated clutch in the transfer case engaged for normal ditching operation. The pressure must be low enough for the clutch to slip if the bucket line is stopped by rock or other obstruction.

b. When the adjusting screw (3, fig. 2-96) is retracted so that no load is transmited through the regulating spring (7) and diaphragm (8), the valve (15) is seated. As the screw is turned in the valve is forced open. Reservoir pressure at the right port of the body (18) acts against the spring load to move the diaphragm up until the spring and air pressure loads are equalized.

c. With no flow demand at the left port of the body, this state of equilibrium occurs with the valve closed. With a flow demand, equilibrium occurs with the valve closed. With a flow demand, equilibrium occurs with the valve open just enough to compensate for demand, thus maintaining the regulated pressure. Any excessive pressure build-up is relieved through the center of the diaphragm and the bonnet vent hole.

9-84. Removal

a. Exhaust air system pressure (para 2-49).

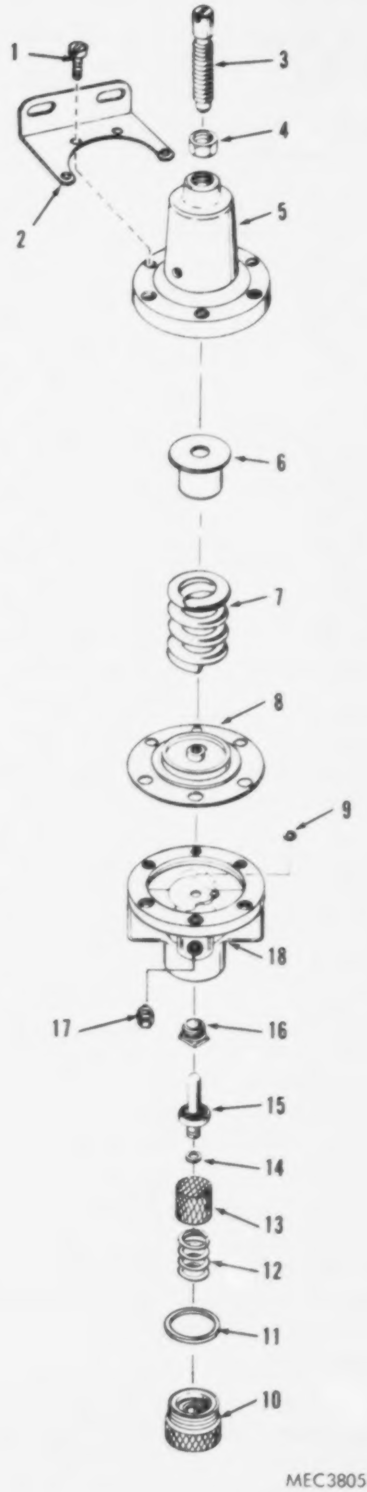
b. Refer to figure 9-25 for the air regulator assembly location.

c. Tag and disconnect both air lines.

d. Remove the two mounting hex nuts, lock washers, and cap screws.

9-85. Disassembly

Disassemble the regulator in the numerical sequence as illustrated on figure 9-26. Use a hooked wire to extract the packing (9) from the body (18). The pipe plug (17) need not normally be removed.



MEC3805-240-35/9-26

1	Screw (8 rqr)
2	Bracket, mounting
3	Screw, adjusting
4	Nut, plain hex

Figure 9-26. Bucket line air regulator assembly, exploded view.

5	Bonnet
6	Rest, upper spring
7	Spring, regulating
8	Diaphragm
9	Packing, preformed
10	Plug, guide
11	Packing, preformed
12	Spring, valve
13	Screen, strainer
14	Packing, preformed
15	Valve
16	Seat, valve
17	Plug, pipe
18	Body

Figure 9-26—Continued

9-86. Cleaning

Clean all parts in a good cleaning solvent. Be sure that air passages in the body, diaphragm, and bonnet are not obstructed.

9-87. Inspection and Repair

a. Inspect all parts for damage and excessive wear. Pay particular attention to the valve contact surface, the valve seat, and the mating surfaces of the top of the valve pin and the center of the diaphragm.

b. The diaphragm, valve, strainer screen, valve return spring, and all packing are available in a kit and can be replaced at the same time.

9-88. Reassembly

a. Install the packing (11, fig. 9-26) on the guide plug (10), the packing (14), on the valve (15), and the packing (9) in the valve pin bore of the body (18).

b. Apply a light coat of grease to the two small packings (9 and 14).

c. Reassemble the remaining parts in the reverse of numerical sequence as illustrated on figure 9-26.

9-89. Test and Adjustment

Note. An air pressure source and an accurate test gage are required for this test and adjustment.

a. Connect an air pressure source to the right port of the body (18, fig. 9-26).

b. Connect an accurate test gage to the left port of the body. Turn the air pressure on.

c. Loosen the lock nut (4) and turn the adjusting screw (3) for a reading of 15 psi on the test gage.

d. Tighten the lock nut and recheck the reading.

e. Apply soap suds at the valve guide cap, the edge of the diaphragm between the body and bonnet, and the bonnet vent hole.

f. Leakage at the cap indicates a defective cap packing.

g. Leakage around the diaphragm shows a defect in the diaphragm or the body or bonnet facing surfaces.

h. Leakage at the vent hole indicates a defective diaphragm or a poor seal between the pin of the valve and its seating surface in the relieving hole in the diaphragm center.

9-90. Installation

Refer to figure 9-25 and install the air regulator assembly in the reverse of the removal procedure.

Note. New assemblies are factory set to 10 psi. Be sure to readjust new assemblies to 15 psi.

Section XIII. SAFETY VALVE

9-91. General

a. The safety valve is a spring loaded ball check valve. One safety valve is mounted on top of each air reservoir. Its purpose is to limit the maximum pressure in the air reservoir should the air system governor fail to function properly. It is set to open when reservoir pressure goes above 150 psi.

b. Air reservoir pressure acts on the teel ball (5, fig. 9-27). When the pressure exceeds 150 psi, the ball is forced off its seat in the body (7), permitting air to escape through the exhaust port in the spring retainer (6). As soon as sufficient air is bled from the air reservoir so that the pressure drops below 150 psi, the valve spring (3) forces the ball back on its seat preventing any further loss of air.

c. Should the safety valve "blow off", the ditcher should be stopped immediately. The safety valve should be checked for an incorrect setting. Also, the governor and the unloading valves in the air compressor should be checked for malfunction.

9-92. Removal

a. Exhaust air system pressure (para 2-49).

b. Remove the safety valve by unscrewing it from its position on the reservoir. Use a wrench only on the hexagon shaped portion of the valve body (7, fig. 9-27).

9-93. Disassembly

Disassemble the safety valve in the numerical sequence as illustrated on figure 9-27.

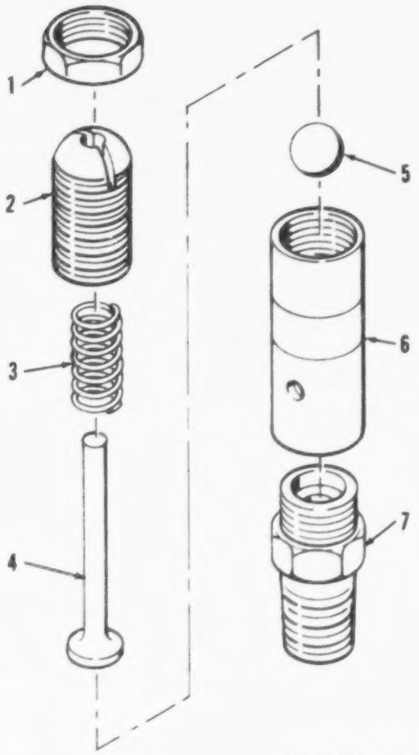
9-94. Cleaning

a. Wash all parts in an oil solvent paying particular attention to the ball (5, fig. 9-27) and its seat. Dry parts thoroughly with compressed air.

b. Check the exhaust port in the spring retainer (6) to be sure it is not plugged.

9-95. Inspection and Repair

a. Inspect the ball valve (5, fig. 9-27) for signs of pitting or scratches. If the ball has evident defects, it should be replaced.



1 Nut, hex lock, 5/8-18
2 Nut, adjusting
3 Spring
4 Pin, release
5 Ball, steel
6 Retainer, spring
7 Body, valve

Figure 9-27. Safety valve, exploded view.

b. Inspect the body (7) and spring retainer (6) and replace if any are found defective.

9-96. Reassembly

Reassemble the safety valve in the reverse of the numerical sequence as illustrated on figure 9-27.

9-97. Test and Adjustment

Note. An accurate test gauge and an air pressure source capable of providing 115 to 155 psi are required for the test and adjustment.

a. Connect the safety valve to an air pressure source of 150 psi as measured on an accurate gage.

b. Loosen the lock nut (1, fig. 9-27) and turn the adjusting nut (2) clockwise until the valve is closed. Then turn the nut counterclockwise until the valve just opens.

c. Reduce the air pressure to 115 psi as measured on the gage.

d. Coat the exhaust port in the spring retainer (6) with soap suds. Leakage should not exceed a one inch soap bubble in one second.

e. Slowly increase the air pressure until the safety valve opens. The safety valve must open between 145 and 155 psi as measured on the test gage.

f. Tighten the lock nut (1) after the adjustment.

9-98. Installation

Install the safety valve in the reverse of the removal procedure.

Section XIV. DRAIN VALVE

9-99. General

a. The drain valve is a remotely controlled valve, used for draining water and oil from the air system. Draining is controlled by a push type valve in the operator compartment.

b. The valve (4, fig. 9-28) is mounted on the stem (9). The tension of the spring (10) normally keeps the valve seated in the body (11). Reservoir air pressure, along with oil and water, appears at the side port in the body.

c. When the reservoirs are to be drained, the push type valve is actuated, providing air pressure at the end port in the body. This pressure acts on the large end of the stem, compressing the spring and unseating the valve. This allows reservoir air pressure to eject the accumulation of oil and water through the spout (2). The bore in the stem provides a vent for the air space between the intermediate and large packing (7 and 8).

9-100. Removal

a. Exhaust air system pressure (para 2-49).

b. Tag and disconnect the air line(s).

c. Unscrew the drain valve from the reservoir.

9-101. Disassembly

Disassemble the drain valve in the numerical sequence as illustrated on figure 9-28. The stem (9) has a screwdriver slot in the larger end to aid in removing the nut (3).

9-102. Cleaning

a. Wash all parts in a cleaning solvent.

b. Be sure that all air passages are clear. Use a wire to clear the small passages in the body and stem.

c. Scrape out the packing grooves in the stem, if necessary, to remove foreign material.

9-103. Inspection and Repair

a. Inspect all parts for cracks, breaks, and other damage.

b. Check the valve (4, fig. 9-28) for wear and scratches.

c. Check the bores and also valve seating surface in the body (11) for nicks and scratches.

d. Check the spout (2) for deterioration and stiffness.

e. Replace the packing (6, 7, and 8) and any other defective parts.

9-104. Reassembly

a. Lubricate the packing (6, 7, and 8, fig. 9-28) the bores of the body (11), and the inside surface of the valve (4), using a barium base grease.

b. Install the packing in their appropriate grooves on the stem (9).

c. Reassemble the remaining parts in the reverse of the numerical sequence as illustrated on figure 9-28. The stem has a screwdriver slot in the large end to aid in installing the nut (3). Leave the spout (2) off for test and adjustment.

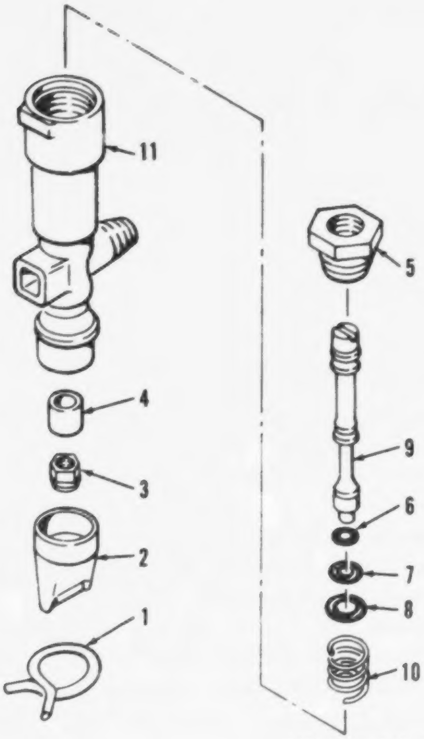
9-105. Test and Adjustment

Note. A variable air pressure source, a second air pressure source (approximately 115 psi), and an accurate test gage are required for this test and adjustment.

a. Connect an air pressure source of approximately 115 psi to the side port in the body (11, fig. 9-28).

b. Use soap suds to check for leakage at the spout end of the body. Leakage should not exceed a one inch soap bubble in one second. Leakage through the vent hole in the stem (9) indicates a defective intermediate packing (7). Other leakage at the spout indicates a defective small packing (6), valve (4), or valve seating surface in the body.

c. Connect a variable air pressure source, with test gage, to the end port in the body.



MEC3805-240-35/9-28

1	Retainer, spout
2	Spout
3	Nut, hex lock, 5/16-24
4	Valve
5	Cap, end
6	Packing, preformed (small)
7	Packing, preformed (intermediate)
8	Packing, preformed (large)
9	Stem, valve
10	Spring, valve
11	Body, valve

Figure 9-28. Drain valve, exploded view.

d. Gradually increase this air pressure until the valve opens. The valve should open between 58 and 82 psi. A slight adjustment can be made by loosening or tightening the nut (3). If the adjustment cannot be made, the spring (10) should be replaced.

e. Reduce the variable air pressure until the valve closes. Use soap suds to check for leakage at the vent hole in the stem. Leakage should not exceed a one inch soap bubble in one second. Any leakage at this point indicates a defective large packing (8).

f. Assemble the spout (2) on the body using the spout retainer (1).

9-106. Installation

a. Install the drain valve in the reverse of the removal procedure.

b. Torque the drain valve to 50 inch pounds maximum.

Section XV. AIR RESERVOIRS

9-107. General

a. Two air reservoirs are used in the air system to store compressed air.A single compartment reservoir is mounted at the front side of the ditcher and is fed directly from the air compressor. A two compartment reservoir, fed from the front reservoir, is mounted on the right side of the ditcher.

b. The reservoirs store enough compressed air to permit several brake applications after the engine is shut down. In addition to the storage function, the reservoirs cool the air to condensate oil and water vapors created during compression. The front reservoir does not feed the air system components directly since it collects most of the oil and water vapors.

c. The two compartment reservoir has a built-in check valve which allows air to pass from the service compartment into the emergency compartment. The emergency air supply permits the release of parking brakes in the event the service air pressure is lost.

9-108. Removal

Remove the single compartment air reservoir (para 2-49) or the two compartment air reservoir (para 2-49).

9-109. Disassembly

The single compartment reservoir is a one piec item and is not disassembled. Disassemble th check valve on the two compartment reservoi in the numerical sequence as illustrated on figure 9-29.

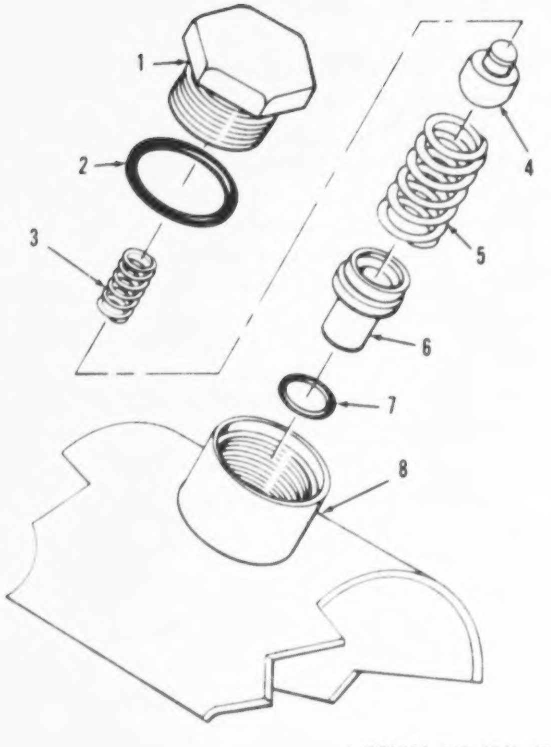
9-110. Cleaning

a. Clean out any sludge accumulation in the reservoir using steam and hot water.

b. On the two compartment reservoir, wash the check valve parts in cleaning solvent.

9-111. Inspection and Repair

a. Inspect the outside of the reservoir for corrosion and damage. A badly damaged reservoir should be replaced as major repairs are not practical.



MEC3805-240-35/9-29

1 Nut, plain cap
2 Packing, preformed
3 Spring, check valve
4 Valve, check
5 Spring, seat
6 Seat, valve
7 Packing, preformed
8 Reservoir

Figure 9–29. Two compartment air reservoir check valve, exploded view.

b. Keep the outside of the reservoir painted to prevent rusting.

c. On the two compartment reservoir, inspect the check valve parts as follows:

(1) Check the valve (4, fig. 9–29) for wear, deterioration, scratches, nicks, and foreign material.

(2) Check the cap nut (1) and springs (3 and 5) for evidence of damage.

(3) Inspect the valve seat (6) for any nicks or scratches on the seating surface.

(4) Replace any unsatisfactory parts and replace the packing (2 and 7).

9–112. Testing

Reservoirs should only be tested with water pressure if the test is made at pressures higher than 150 psi.

9–113. Reassembly

The single compartment reservoir is a one piece item and is not reassembled. Reassemble the check valve on the two compartment reservoir in the reverse of the numerical sequence as illustrated on figure 9–29.

9–114. Installation

Install the single compartment air reservoir (para 2–49) or the two compartment air reservoir (para 2–49).

Section XVI. CHECK VALVES

9–115. General

This section covers the single and double check valves used in the air system of the ditcher. A check valve is also built into the two compartment air reservoir. This check valve is covered with the reservoir.

9–116. Single Check Valve

a. General.

(1) Single check valves are used at two locations on the ditchers to limit air flow to one direction only. One valve is used to block air flow from the front-mounted air reservoir out the left-hand towing hose coupling. The other valve is used to block air flow from the service compartment of the side-mounted reservoir to the front-mounted reservoir. This prevents a sudden loss of pressure should a defect develop in the air compressor or associated front-end components.

(2) The single check valve contains a spring loaded disc (4, fig. 9–30) which normally rests against the seat (3). Air flow in the normal direction moves the valve from its seat and the flow is unobstructed. Flow in the reverse direction is prevented by seating of the disc, which is caused by the action of the spring (5) and assisted by the air pressure.

b. Removal.

(1) Exhaust air system pressure (para 2–49).

(2) Tag and disconnect the air line.

(3) Unscrew the check valve from the tee on the reservoir.

(4) Unscrew the elbow or the shut-off cock and nipple from the check valve.

c. Disassembly. Disassemble the single check valve in the numerical sequence as illustrated on figure 9-30. The spring guide (6), which is pressed in place, need not be removed unless there is evidence of damage or excessive wear.

d. Cleaning. Clean all parts in a cleaning solvent.

e. Inspection and Repair.

(1) Inspect the valve disc (4, fig. 9-30) and the valve seat (3) for pitting and corrosion.

(2) Inspect all parts for cracks and damage.

(3) Replace any unsatisfactory parts.

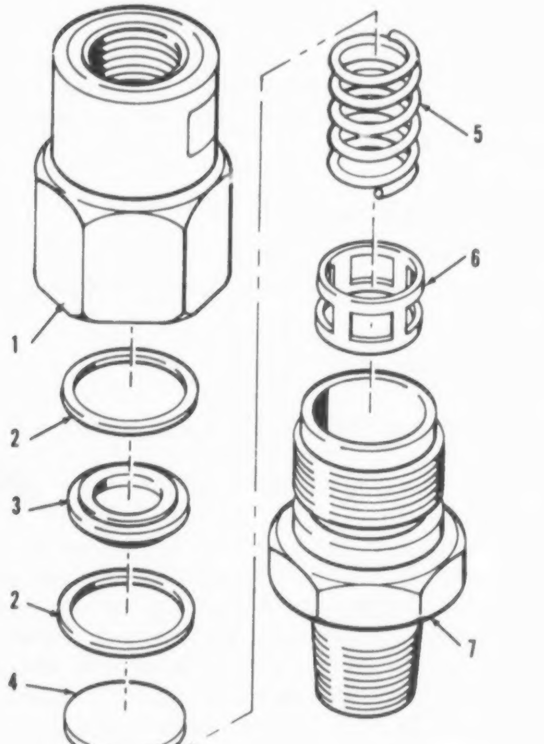
f. Reassembly. Reassemble the single check valve in the reverse of the numerical sequence as illustrated on figure 9-30.

g. Leakage Test.

(1) Apply a 115 psi air pressure against the normal air flow of the check valve.

(2) Coat the opposite end of the check valve with soap suds.

(3) Leakage should not exceed a one inch soap bubble in one second.



MEC3805-240-35/9-30

1 Body, valve
2 Washer
3 Seat, valve
4 Disc, valve
5 Spring,
6 Guide, spring
7 Cap

Figure 9-30. Check valve (single), exploded view.

h. Installation. Install the check valve in the reverse of the removal procedure.

9-117. Double Check Valve

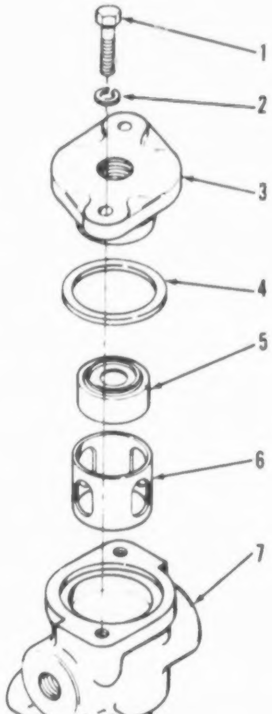
a. General.

(1) Double check valves are used at three locations on the ditcher to automatically direct the flow of air pressure into one or two air lines from either of two other lines.

(2) As air pressure enters the top or bottom inlet port of the check valve, the pressure moves the disc valve (5, fig. 9-31) to seat against the cover (3) or body (7) and thereby block the opposite port. The air pressure at the top or bottom inlet port is available at both side outlet ports in the body.

b. Removal.

(1) Exhaust air system pressure (para 2-49).



MEC3805-240-35/9-31

1 Screw, hex cap, 5/16-18 x 7/8 (2 rqr)
2 Washer, lock, 5/16 (2 rqr)
3 Cover
4 Packing, preformed
5 Valve
6 Guide, valve
7 Body

Figure 9-31. Double check valve, exploded view.

(2) Refer to figure 9-25 for location of the differential lock-up and emergency brake double check valves.

(3) Tag and disconnect all air lines.

(4) Remove the mounting cap screw and lock washer (and hex nut where used).

(5) Unscrew bushing, elbows, or pipe plugs from the valve.

c. Disassembly. Disassemble the double check valve in the numerical sequence as illustrated on figure 9-31.

d. Cleaning. Clean all metal parts in a cleaning solvent.

e. Inspection and Repair.

(1) Examine the rubber valve (5, fig. 9-31) for signs of cracking, wear, and damage.

(2) Inspect the cover (3) and body (7) for cracks and damage.

(3) Inspect the valve seating surfaces on the cover and body for pitting, nicks, and scratches.

(4) Replace any unsatisfactory parts and replace the packing (4).

f. Reassembly. Reassemble the double check valve in the reverse of the numerical sequence as illustrated on figure 9-31.

g. Leakage Test.

(1) Plug the two outlet ports in the sides of the body.

(2) Apply an air pressure of 115 psi to the inlet port in the bottom of the body.

(3) Coat the inlet port in the cover with soap suds.

(4) Leakage should not exceed a three inch soap bubble in three seconds.

(5) Repeat the test in the opposite direction by applying the air pressure at the inlet port in the cover and checking with soap suds at the inlet port in the bottom of the body.

h. Installation. Install the double check valve in the reverse of the removal procedure.

Section XVII. PRESSURE SWITCHES

9-118. General

a. Four pressure sensitive switches are used in the air system to monitor air pressure at certain points. Each switch contains electrical contacts which connect to a visual or aural indicator.

b. The emergency brake pressure switch is used in the air line to the spring brake section of the brake chamber. When the emergency brakes are applied, the air line is exhausted and the switch contacts close. This lights the emergency brake warning lamp.

c. The low pressure switch is used in an air line which has continuous full system pressure. If the air pressure drops below the required minimum, the switch contacts close to energize a warning buzzer.

d. The differential lock-up switch is used in the air line to the differential lock-up power cluster. When air pressure is applied to lock up the axles, the switch contacts close to light the inter axle lock-up lamp.

e. The stop light switch connects to the brake valve. When a service brake application is made, the switch contacts close to light the stop lights.

9-119. Low Pressure and Emergency Brake Pressure Switches

a. General.

(1) The low pressure and emergency brake switches are very similar in construction. Both switches have normally closed contacts. In the low pressure switch, the contacts open at 60 psi. In the emergency brake switch, the contacts open at 30 psi.

(2) The diaphragm (16, fig. 9-32) is clamped between the cover (7) and the body (25) to seal off the cavity in the body. Air pressure enters the port in the body to act on the diaphragm against the tension of the spring (10).

(3) When air pressure is high enough to overcome spring tension, the diaphragm carries the contact screw (18) away from the terminal screw (23). In this condition the switch contacts (17 and 22) are open.

(4) When air pressure drops sufficiently, the spring forces the contact screw (18) down and its contact touches the contact on the terminal screw (23). This completes an electrical path through the terminal screw, contact screw, diaphragm washer (15), spring (10), terminal screw washer (8), and terminal screw (9).

b. Removal.

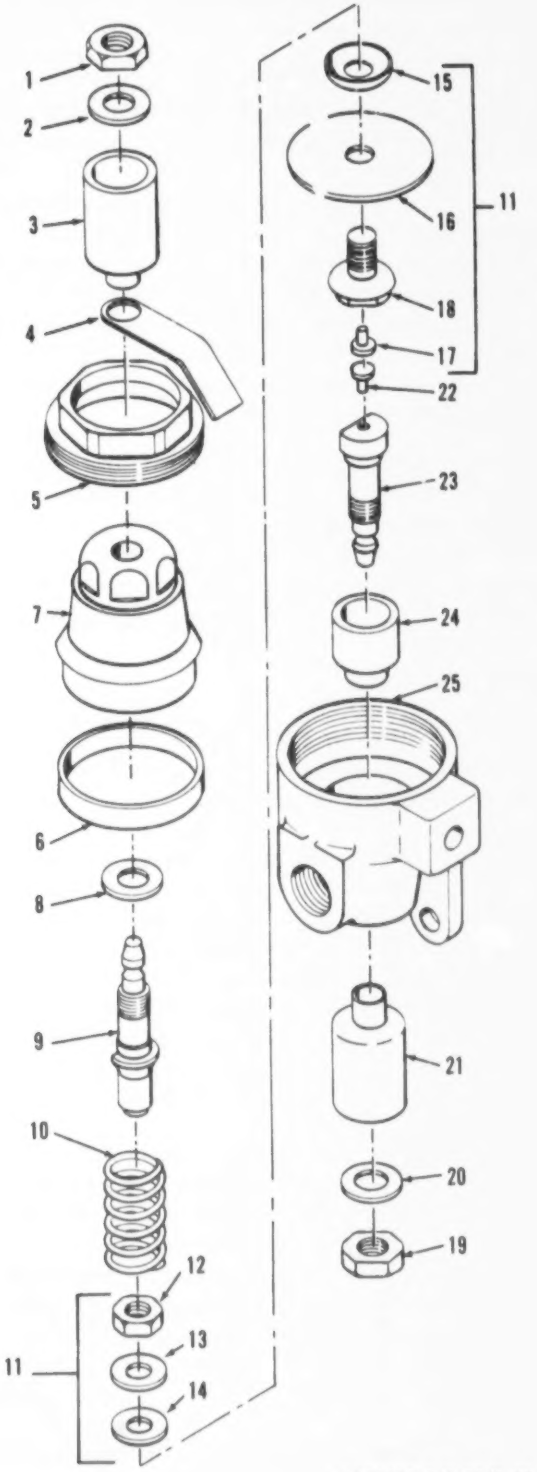
(1) Exhaust air system pressure (para 2-49).

(2) Refer to figure 9-25 for the emergency brake pressure switch location.

(3) Tag and disconnect both air lines and both wires.

(4) Remove the two mounting hex nuts, lock washers, and cap screws.

(5) Unscrew the tee from the switch.



1	Nut, hex, 10-32	3	Shell
2	Washer, No. 10	4	Tag, date

Figure 9-32. Pressure switch (low pressure or emergency brake pressure), exploded view.

5	Retainer, cover	16	Diaphragm
6	Ring, sealing	17	Contact
7	Cover	18	Screw, contact
8	Washer, terminal screw	19	Nut, hex, 10-32
9	Screw, terminal	20	Washer, No. 10
10	Spring	21	Shell
11	Diaphragm assembly	22	Contact
12	Nut, hex, 10-32	23	Screw, terminal
13	Shim (as required)	24	Bushing, terminal
14	Shim (as required)	25	Body
15	Washer, diaphragm		

Figure 9-32—Continued

c. Disassembly. Disassemble the low pressure or emergency brake pressure switch in the numerical sequence as illustrated on figure 9-32. Leave the contacts (17 and 22) in place in the contact screw (18) and terminal screw (23).

d. Cleaning. Wash all parts in a cleaning solvent. Check that all holes and ports are clear of any foreign material.

e. Inspection and Repair.

(1) Examine the diaphragm (16, fig. 9-32) for signs of cracking, wear, and damage.

(2) Check all parts for distortion, cracks, and chips.

(3) Check the shells (3 and 21) and the terminal bushing (24) for wear and deterioration.

(4) Replace any unsatisfactory parts.

(5) If necessary, correct minor pitting of the contacts (17 and 22) using a fine file. If the contacts are excessively pitted or worn, pry them out and press new contacts into the contact screw (18) and terminal screw (23).

(6) Use a fine sandpaper to assure good electrical contact surfaces on metallic parts other than the two contacts. These surfaces are on the washer (8), terminal screw (9), spring (10), parts of the diaphragm assembly (11), and the terminal screw (23).

(7) Spray the inside of the cover (7) with a moisture and fungus proof varnish.

f. Reassembly. Reassemble the low pressure or emergency brake pressure switch in the reverse of the numerical sequence as illustrated on figure 9-32.

g. Test and Adjustment.

Note. A variable air pressure source, an accurate test gauge, a battery, and buzzer are required for this test and adjustment.

(1) Connect a variable air pressure source and an accurate test gauge to the port of the switch.

(2) Adjust the air pressure to 150 psi. Use soap suds to check for leakage. No leakage at any point is permissable. Leakage at the vent hole

in the body (25, fig. 9-32) indicates a ruptured diaphragm (16).

(3) Connect the battery and buzzer in series with the two terminals of the switch. Slowly decrease the air pressure and note the pressure when the buzzer sounds to indicate that the contacts have closed.

(4) For the low pressure switch, the contacts must close between 54 and 66 psi.

(5) For the emergency brake pressure switch, the contacts must close between 24 and 36 psi.

(6) If the closure pressure is incorrect, add or remove shimming. Adding shims (13 and/or 14) raises the pressure at which the contacts close. Removing shims lowers the pressure.

(7) If changing the shimming does not provide correct operation, the spring (10) must be replaced.

h. Installation. Install the low pressure switch or emergency brake pressure switch in the reverse of the removal procedure.

9-120. Stop Light and Differential Lock-Up Pressure Switches

a. General.

(1) The stop light and differential lock-up pressure switches are very similar in construction. Both switches have normally open contacts. In the stop light switch, the contacts close at 5 psi. In the differential lock-up switch, the contacts close at 30 psi.

(2) The diaphragm (7, fig. 9-33) is clamped between the upper body (17) and the lower body (6) to seal off the cavity in the body. Air pressure enters the port in the body to act on the diaphragm against the tension of the spring (10).

(3) When air pressure is high enough to overcome spring tension, the diaphragm raises the contact plunger (9), causing its contact (8) to touch the contact (11) on the terminal screw (12). This completes an electrical path through the terminal screw (13, terminal connector (16), shims (14 and 15) if used, spring (10), contact plunger (9), and terminal screw (12). When air pressure reduces sufficiently, the spring forces the contact plunger down to open the contacts.

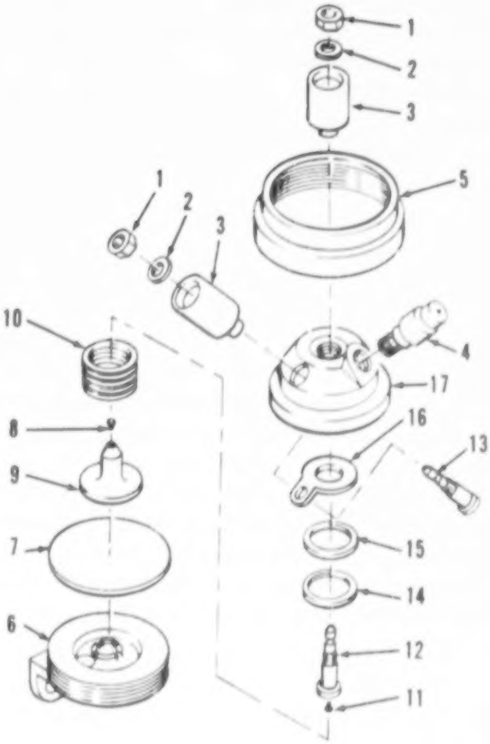
b. Removal.

(1) Exhaust air system pressure (para 2-49).

(2) Refer to figure 9-25 for differential lock-up pressure switch location.

(3) Tag and disconnect both air lines and both wires.

(4) Remove the two mounting hex nuts, lock washers, and cap screws.



MEC3805-240-35/9-33

1 Nut, hex plain, 10-32 (2 rqr)
2 Washer, No. 10 (2 rqr)
3 Shell (2 rqr)
4 Valve assembly, breather
5 Body, adapter
6 Body, switch, lower
7 Diaphragm
8 Contact
9 Plunger, contact
10 Spring
11 Contact
12 Screw, terminal
13 Screw, terminal
14 Shim (as required)
15 Shim (as required)
16 Connector, terminal
17 Body, upper

Figure 9-33. Stop light or differential lock-up pressure switch, exploded view.

(5) Unscrew the tee from the switch.

c. Disassembly. Disassemble the stop light or differential lock-up pressure switch in the numerical sequence as illustrated on figure 9-33. Leave the contacts (8 and 11) in place in the contact plunger (9) and terminal screw (12).

d. Cleaning. Wash all parts in a cleaning solvent. Check that all holes and ports are clear of any foreign material.

e. Inspection and Repair.

(1) Examine the diaphragm (7, fig. 9-33) for signs of cracking, wear, and damage.

(2) Check all parts for distortion, cracks, and chips.

(3) Check the shells (3) for wear and deterioration.

(4) Replace any unsatisfactory parts.

(5) If necessary, correct minor pitting of the contacts (8 and 11) using a fine file. If the contacts are excessively pitted or worn, pry them out and press new contacts into the contact plunger (9) and terminal screw (12).

(6) Use a fine sandpaper to assure good electrical contact surfaces on metallic parts other than the two contacts. These surfaces are on terminal screw (13), terminal connector (16), shims (14 and 15) if used, spring (10), contact plunger (9), and terminal screw (12).

(7) Spray the inside of the upper body (17) with a moisture and fungus proof varnish.

f. Reassembly. Reassemble the stop light or differential lock-up pressure switch in the reverse of the numerical sequence as illustrated on figure 9-33.

g. Test and Adjustment.

Note. A variable air pressure source, an accurate test gage, a battery, and buzzer are required for this test and adjustment.

(1) Connect a variable air pressure source and an accurate test gage to the port of the switch.

(2) Adjust the air pressure to 150 psi. Use soap suds to check for leakage. No leakage at any point is permissible. Leakage at the breather valve assembly (4, fig. 9-33) indicates a ruptured diaphragm (7).

(3) Reduce the pressure to 0 psi and connect the battery and buzzer in series with the two terminals of the switch. Slowly increase the air pressure and note the pressure when the buzzer sounds to indicate that the contacts have closed.

(4) For the stop light pressure switch, the contacts must close between 2 and 5 psi.

(5) For the differential lock-up pressure switch, the contacts must close between 27 and 33 psi.

(6) If the closure pressure is incorrect, add or remove shimming. Adding shims (14 and/or 15) raises the pressure at which the contacts close. Removing shims lowers the pressure.

(7) If changing the shimming does not provide correct operation, the spring (10) must be replaced.

h. Installation. Install the stop light pressure switch or differential lock-up pressure switch in the reverse of the removal procedure.

Section XVIII. TOGGLE TYPE CONTROL VALVE

9-121. General

a. Four toggle type control valves are used on the ditcher. Three are mounted at the driver's station and one at the ditching station. One valve controls air pressure from the brake valve to the limiting and quick release valve or dry road/slippery road operation. A second valve controls application of air pressure from the emergency compartment of the two compartment reservoir to the spring brake sections of the brake chambers. The other two valves control air pressure to the differential lock-up power cluster, providing lock-up selection from either operating position.

b. Supply air pressure enters the port in the cap nut (7, fig. 9-34). With the lever in the actuated position, the hollow stemmed plunger (5) pushes the valve (10) down, unseating it. This allows air to flow to the open delivery port in the body (12). The stem of the plunger is sealed off because of its pressure on the top of the valve. The packing (4) provides a seal between the delivery port and the two exhaust holes in the body.

c. When the lever is moved to the unactuated position, the plunger return spring (6) moves the plunger up. The tension of the valve spring (9) causes the valve to seat, cutting off supply air pressure. Air pressure in the lines and components fed by the valve is exhausted through the hollow stem, the holes near the top of the plunger, and the exhaust holes in the body.

9-122. Removal

a. Exhaust air system pressure (para 2-49).

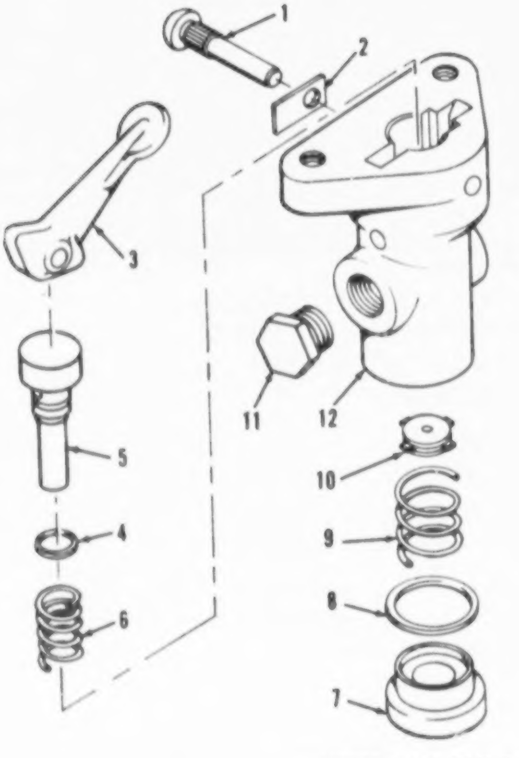
b. Refer to figure 9-25 for the differential lock-up toggle type control valve location.

c. Remove the two mounting screws and lock washers.

d. Tag and disconnect both air lines.

9-123. Disassembly

Disassemble the toggle type control valve in the numerical sequence as illustrated on figure 9-34. The pin (1) can be driven out with a punch.



MEC3805-240-35/9-34

1	Pin	7	Nut, cap
2	Tag, date	8	Packing, preformed
3	Lever	9	Spring, valve
4	Packing, preformed	10	Valve
5	Plunger	11	Plug, pipe
6	Spring, plunger return	12	Body

Figure 9-34. Toggle type control valve, exploded view.

9-124. Cleaning

a. Wash all parts in a cleaning solvent.

b. Be sure that all air passages are clear. Use a wire to check the hollow plunger (5, fig. 9-34) and the two exhaust holes in the body (12).

c. If necessary, scrape the packing grooves in the plunger and cap nut (7).

9-125. Inspection and Repair

a. Inspect all parts for cracks, breaks, and other damage.

b. Check the valve (10, fig. 9-34) for wear, deterioration, and scratches. If not defective on both sides, the valve can be turned over.

c. Check the valve seating surfaces in the body (12) and on the bottom of the plunger (5) for nicks and scratches. Minor irregularities may be corrected with crocus cloth.

d. Check the bore in the body for nicks and scratches.

e. Replace the packing (4 and 8) and any defective parts.

9-126. Reassembly

a. Lubricate the packing (4, fig. 9-34) plunger (5), pin (1), and the cam surface of the lever (3) with a barium base grease. Install the packing in the groove of the plunger.

b. Reassemble the toggle type control valve in the reverse of the numerical sequence as illustrated on figure 9-34.

9-127. Leakage Test

Note. An air pressure source is required for this test.

a. Connect an air pressure source of approximately 115 psi to the port in the cap nut (7, fig. 9-34). Place the lever (3) in the unactuated position, plunger (5) raised.

b. Use soap suds to check for leakage at the open delivery port of the body (12) and around the cap nut. Leakage at any point should not exceed a one inch soap bubble in one second. Leakage at the cap nut indicates a defective packing. Leakage at the delivery port indicates a defective valve (10) or seating surface in the body.

c. Plug the open port and place the lever in the actuated position, plunger depressed. Use soap suds to check for leakage at an exhaust hole in the body. Leakage in excess of a one inch soap bubble in one second indicates a defective packing (4), valve (10), or valve seating surface on the bottom of the plunger.

9-128. Installation

Install the toggle type control valve in the reverse of the removal procedure.

Section XIX. DRAIN CONTROL PUSH VALVE

9-129. General

a. The drain control push valve is located in the operator compartment and is used as a remote control for the three drain valves mounted on the reservoirs. When depressed, the drain control valve provides system air pressure to open the drain valves.

b. System air pressure is connected to the supply port in the cap nut (4, fig. 9-35). The spring

(5) normally keeps the valve (7) seated in the body (10). This blocks the delivery port in the side of the body. When the button (2) is pushed, the stem (9) unseats the valve, allowing air flow through the delivery port. When the valve again seats, air in the delivery lines escapes through the small exhaust hole in the side of the body.

9-130. Removal

a. Exhaust air system pressure (para 2-49).

b. Drive the spiral pin out of the button and pull off the button.

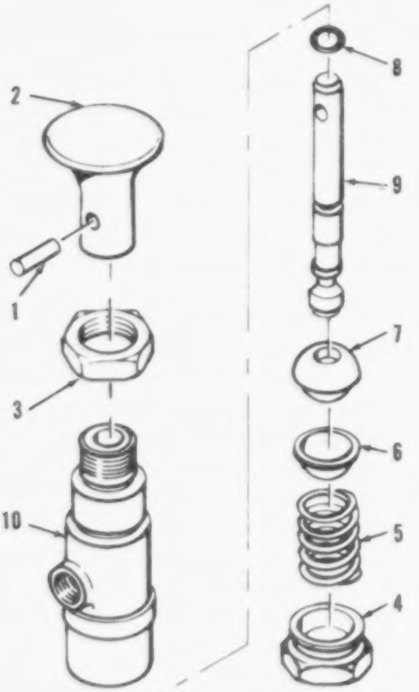
c. Remove the mounting nut.

d. Tag and disconnect both air lines.

e. Unscrew the elbow from the valve.

9-131. Disassembly

Disassemble the drain control push valve in the numerical sequence as illustrated on figure 9-35.



MEC3805-240-35/9-35

1 Pin, spiral
2 Button
3 Nut
4 Nut, cap
5 Spring
6 Seat, spring
7 Valve, inlet
8 Packing, preformed, stem
9 Stem
10 Body

Figure 9-35. Drain control push valve, exploded view.

The pin (1), button (2), and nut (3) are taken off during removal.

9-132. Cleaning

a. Wash all parts in a cleaning solvent. Check that the air passages are clear.

b. Use a wire to be sure the small exhaust hole in the side of the body is clear.

c. Scrape out the packing groove in the stem if necessary.

9-133. Inspection and Repair

a. Inspect all parts for cracks, breaks, and other damage.

b. Inspect the valve for scratches, wear, and deterioration.

c. Inspect the valve seat and stem bore in the body for nicks and scratches.

d. Replace the packing and any other part found defective. Replace the spring if it has lost its tension.

9-134. Reassembly

a. Lubricate the stem bore in the body with a barium base grease.

b. Reassemble the drain control valve in the reverse of the numerical sequence as illustrated on figure 9-35. The pin (1), button (2), and nut (3) are assembled when the valve is installed.

9-135. Leakage Test

Note. An air pressure source of 115 psi is required for this test.

a. Plug the delivery port in the side of the body (10, fig. 9-35).

b. Connect an air pressure source of 115 psi to the supply port in the cap nut (4).

c. With the valve depressed, use soap suds to check for leakage at the small exhaust hole in the side of the body and at the top of the valve. Leakage in excess of a one inch soap bubble in one second indicates defective packing (8).

d. With the valve released, again check for leakage at the exhaust hole. Leakage in excess of a one inch soap bubble in one second indicates a defective valve (7).

9-136. Installation

Install the drain control valve in the reverse of the removal procedure.

Section XX. EMERGENCY BRAKE PUSH-PULL CONTROL VALVE

9-137. General

a. The emergency brake control valve is located at the operator compartment. The valve is used to shut off or supply air pressure to the spring brake sections of the brake chambers. The valve automatically shuts off the air supply, to actuate the spring brakes, if system air pressure drops to 40 psi.

b. When the emergency brakes are released, the plunger (14, fig. 9-36) is depressed, causing the valve (12) to unseat in the body (17). This allows system pressure at the center, supply port to appear at the left, delivery port, feeding the brake chamber. At the same time, the valve seats in the cover (8) to block the exhaust port in the bottom of the cover.

c. When the emergency brakes are applied, the plunger is raised, lifting the valve up. The valve seats in the body to block off system pressure supply at the center port. The valve also unseats from the cover, opening the exhaust port. This allows pressure in the lines, appearing at the left hand delivery port to exhaust.

d. At normal system pressure, the depressed valve remains in its depressed position unless the plunger is pulled up. This is due to system pressure acting on the upper surface of the valve to overcome the tension of the spring (15). If system pressure drops to 40 psi, spring tension overcomes air pressure to raise the plunger and consequently the valve.

9-138. Removal

a. Exhaust air system pressure (para 2-49).

b. Refer to figure 9-37 and remove the emergency brake control valve.

9-139. Disassembly

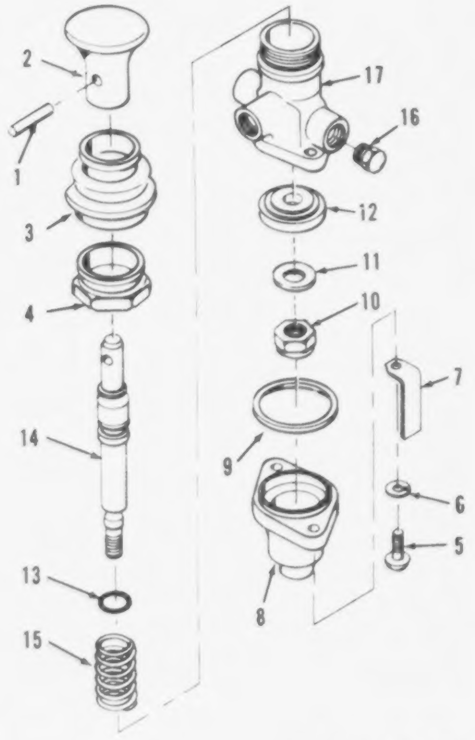
Disassemble the emergency brake control valve in the numerical sequence as illustrated on figure 9-36. The pins (1), button (2), boot (3), and hex nut (4) are taken off during removal.

9-140. Cleaning

a. Wash all parts in a cleaning solvent.

b. Check that all air passages are clear and free of any foreign material. Pay particular attention to the small hole inside the supply port.

c. Remove any foreign material from the valve, its seating surfaces, the packing groove in the plunger, and the bore in the top of the body.



MEC3805-240-35/9-36

1	Pin, spiral
2	Button
3	Boot
4	Nut, hex
5	Screw, phillips head machine, 1/4-20 x 5/8 (2 rqr)
6	Washer, lock, 5/8 (2 rqr)
7	Tag, date
8	Cover
9	Packing, preformed
10	Nut, hex, 1/4-28
11	Washer
12	Valve, inlet and exhaust
13	Packing, preformed, stem guide
14	Plunger
15	Spring
16	Plug, pipe
17	Body

Figure 9-36. Emergency brake push-pull control valve, exploded view.

9-141. Inspection and Repair

a. Inspect all parts for cracks, breaks, and other damage.

b. Check the valve (12, fig. 9-36) for wear, deterioration, and scratches.

c. Check the valve seating surfaces in the body for nicks and scratches. Small irregularities may be corrected with a crocus cloth.

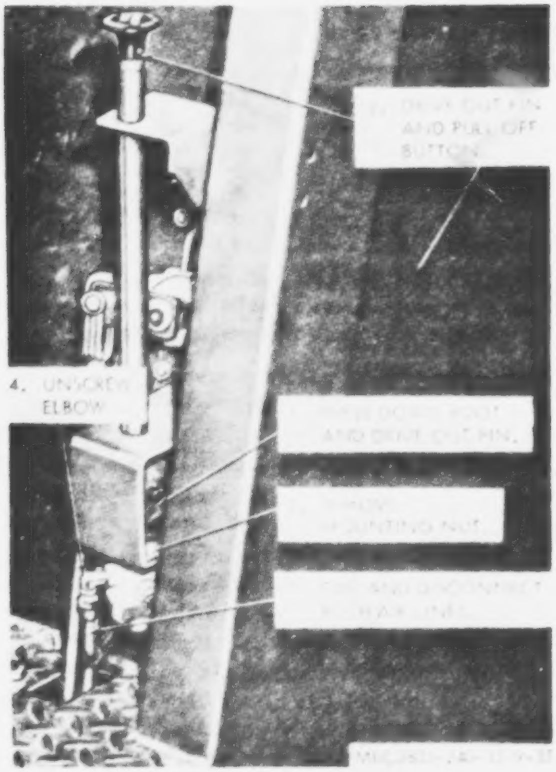


Figure 9-37. Emergency brake push-pull control valve removal and installation.

d. Check the bore in the top of the body for nicks and scratches.

e. Replace the packing (9 and 13) and any defective parts.

9-142. Reassembly

a. Lubricate the packing (13, fig. 9-36), the bore in the top of the body (17), and the plunger (14) using a barium base grease. Install the packing in the groove of the plunger.

b. Reassemble the emergency brake control valve in the reverse of the numerical sequence as illustrated on figure 9-36. Leave the pins (1), button (2), boot (3), and hex nut (4) disassembled. Torque the hex nut (10) to 30 to 40 inch pounds.

9-143. Operational and Leakage Test

Note. A variable air pressure source and an accurate test gage are required for this test.

a. Connect a variable air pressure source and test gauge to the center, supply port in the body (17, fig. 9-36). Plug the open delivery port.

b. Apply 115 psi air pressure as measured on the gage. Use soap suds to check for leakage.

c. Leakage in excess of a one inch soap bubble in one second is not permissible. Leakage at the plunger (14) indicates defective packing (13). Leakage at the exhaust port indicates a defective valve (12) or seating surface in the body.

d. Depress the plunger and let it remain depressed. Use soap suds to check for leakage.

e. Leakage in excess of a one inch soap bubble in a one second is not permissible. Leakage at the exhaust port indicates a defective valve or seating surface in the cover (8). Leakage between the cover and body indicates defective packing (9).

f. Slowly decrease air pressure until the plunger moves up. This should occur between 35 and 45 psi. If not, disassemble the valve and replace the spring (15).

9-144. Installation

Refer to figure 9-37 and install the emergency brake control valve.

Section XXI. BUCKET LINE CONTROL PUSH-PULL AIR VALVE

9-145. General

a. The bucket line control valve is mounted at the ditcher control station and is used to start and stop bucket line operation.

b. With the knob (1, fig. 9-38) pulled out, air passes from the lower port to the upper port in the body (15) to activate the system. The large packing (10) seats in the valve body cap (7) to block the upper port from the exhaust port in the valve body cap.

c. When the knob is pushed in, the small packing (11) seats in the body to block the lower port from the upper port. Air in the lines exhausts through the body upper port and the valve body cap exhaust port. The piston packing (13) provides a continuous seal at the bottom of the valve body.

9-146. Removal

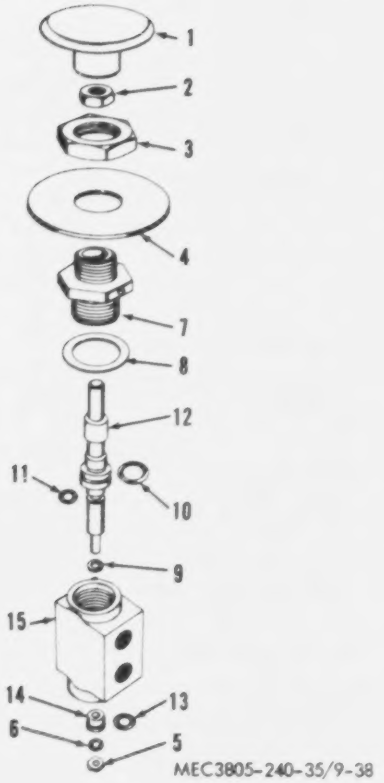
a. Exhaust air system pressure (para 2-49).

b. Refer to figure 9-25 for the bucket line control valve location.

c. Hold the small lock nut on the front of the valve and unscrew the knob.

d. Remove the mounting nut and the nameplate.

e. Tag and disconnect both air lines.



1	Knob, valve pull
2	Locknut, 1/4-28 Unf
3	Nut, valve mounting 5/8-18 Unf
4	Nameplate
5	Nut, hex, 6-32 NC
6	Washer, lock, internal tooth No. 6
7	Cap, valve body
8	Gasket, end cap
9	Gasket, valve
10	Packing, preformed
11	Packing, preformed, small
12	Stem, valve
13	Packing, preformed, piston
14	Piston
15	Body, valve

Figure 9-38. Bucket line push-pull air valve, exploded view.

9-147. Disassembly

Disassemble the valve in the numerical sequence as illustrated on figure 9-38. The knob (1), lock-nut (2), mounting nut (3), and nameplate (4) are disassembled during removal of the valve. Use a hooked wire to extract the piston (14) from the body (15).

9-148. Cleaning

Clean all parts in a good cleaning solvent. Be sure that air passages in the body and valve body cap are not obstructed.

9-149. Inspection and Repair

a. Inspect all parts for damage and excessive wear.

b. Check for scoring at the packing surfaces in the stem bore of the body and in the valve body.

c. The three packings and two gaskets are available in a kit and should all be replaced when the valve is repaired.

9-150. Reassembly

a. Install the packing (10 and 11, fig. 9-38) and the copper gasket (9) on the valve stem (12) and insert the valve stem into the body (15).

b. Install the packing (13) on the piston (14) and slide it onto the bottom of the valve stem. Secure it with the lock washer (6) and the nut (5).

c. Place the fiber gasket (8) on the valve body cap (7) and screw the cap into the valve body.

d. The nameplate (4), mounting nut (3), locknut (2), and knob (1) are assembled during installation of the valve.

9-151. Leakage Test

Note. An air pressure source of 115 psi is required for this test.

a. Connect air pressure of 115 psi to the lower port in the valve body (15, fig. 9-38). Plug the upper port in the body.

b. With the knob (1) pulled out, use soap suds to check for leakage at the exhaust port. Leakage should not exceed a one inch soap bubble in one second. Excessive leakage indicates a defective large packing (10).

c. With the knob pushed in, use soap suds to check for leakage at the exhaust port and also at the bottom of the valve. Leakage at any point should not exceed a one inch soap bubble in one second. Excessive leakage indicates a defective small packing (11) or piston packing (13).

9-152. Installation

Install the bucket line control valve in the reverse of the removal procedure.

Section XXII. LOW AIR PRESSURE INDICATOR

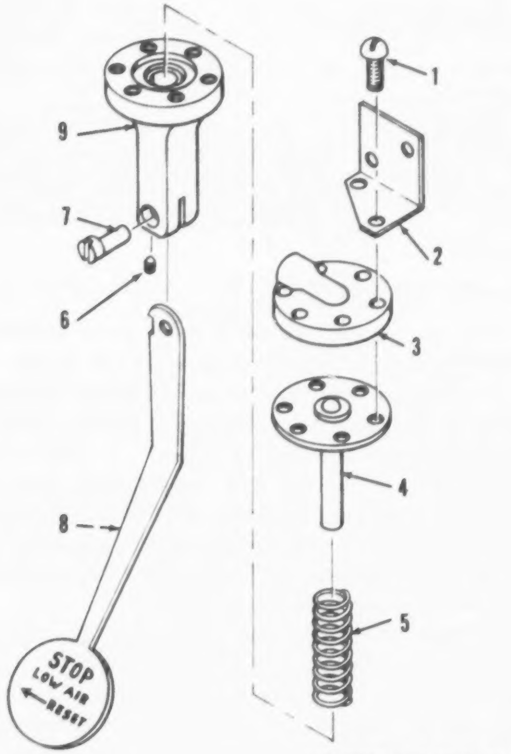
9-153. General

a. The low pressure indicator is mounted in the operator compartment. When system air pressure drops below the safe level, a warning sign plate drops into the driver's field of vision.

b. System air pressure is normally supplied at the port in the upper housing (3, fig. 9-39). This pressure keeps the diaphragm and plunger assembly (4) depressed. The bottom of the plunger fits into the notch in the shaft (8), keeping it in a horizontal position.

c. If air pressure is reduced, the diaphragm and plunger assembly is forced up by the spring (5). If air pressure reduces to the critical level, the bottom of the plunger is lifted out of the notch in the shaft, allowing it to drop to the verical position.

d. The cam pivot adjusting stud is turned to adjust spring tension so the sign plate and shaft drops at the desired system pressure. The cam set screw locks the cam pivot adjusting stud in place after adjustment.



MEC3805-240-35/9-39

1 Screw (6 rqr)
2 Bracket, mounting
3 Housing, upper
4 Diaphragm and plunger assembly
5 Spring
6 Screw, cam set
7 Stud, cam pivot adjusting
8 Shaft
9 Housing, lower

Figure 9-39. Low air pressure indicator, exploded view.

9-154. Removal

a. Exhaust air system pressure (para 2-49).
b. Tag and disconnect the air line and adaptor.
c. Remove the two mounting hex nuts, lock washers, and cap screws.

9-155. Disassembly

Disassemble the low air pressure indicator in the numerical sequence as illustrated on figure 9-39.

9-156. Inspection and Repair

a. Inspect all metal parts for cracks, breaks, and excessive wear.
b. Inspect the diaphragm for cracks, holes, and deterioration.
c. Check the facing surfaces of the upper housing (3, fig. 9-39) and lower housing (9) for scratches and nicks.
d. Replace any parts that are defective.

9-157. Reassembly

Reassemble the low air pressure indicator in the reverse of the numerical sequence as illustrated on figure 9-39.

9-158. Operational and Leakage Test

Note. An accurate test gage and a variable air pressure source are required for this test.

a. Connect a variable air pressure source and test gage to the port in the upper housing (3, fig. 9-39).

b. Adjust the applied air pressure to 150 psi as measured on the test gage.

c. Use soap suds to check for any leakage at the bottom of the lower housing (9) and between the upper and lower housing.

d. Reduce the applied air pressure to 60 psi as measured on the test gage.

e. Loosen the cam set screw (6) and turn the cam pivot adjusting stud (7) until the shaft will stay in the horizontal position. Adjust the cam pivot adjusting stud until the shaft just drops. Retighten the cam set screw.

f. Check the adjustment by raising and lowering the air pressure several times. The shaft must drop between 54 and 66 psi.

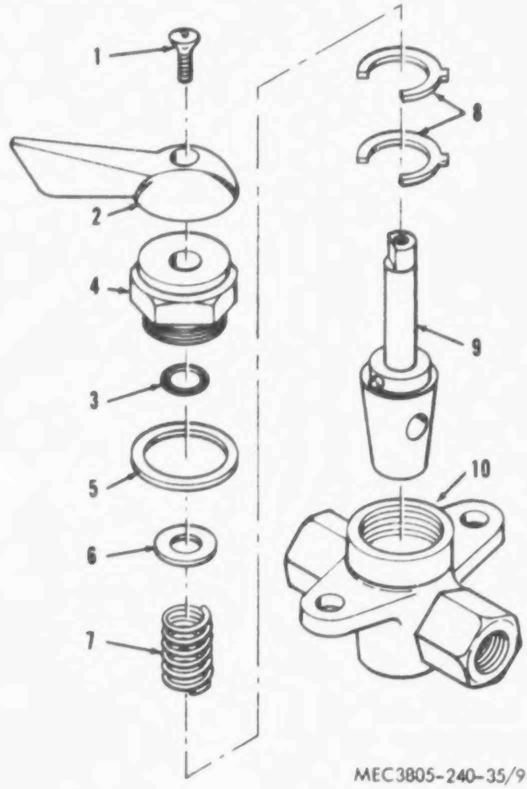
9-159. Installation

Install the low air pressure indicator in the reverse of the removal procedure.

Section XXIII. INDICATO RSHUTOFF VALVE

9–160. General

The indicator shutoff valve (fig. 9–40) is mounted in the air line to the low pressure indicator. The valve is used to close off the air line, to exclude foreign matter, when the windshield of the ditcher is removed for shipment.



MEC3805-240-35/9-40

1	Screw	6	Washer
2	Handle	7	Spring
3	Packing, preformed	8	Stop (2 rqr)
4	Cap, body	9	Plug, assembly
5	Washer, bonnet	10	Body

Figure 9–40. Indicator shutoff valve, exploded view.

9–161. Removal

a. Exhaust air system pressure (para 2–49).

b. Remove the handle screw and take off the handle.

c. Remove the two mounting hex nuts, lock washers, and cap screws.

d. Tag and disconnect both air lines.

e. Unscrew the two elbows.

9–162. Disassembly

Disassemble the valve in the numerical sequence as illustrated on figure 9–40. The screw (1) and handle (2) are taken off during removal.

9–163. Cleaning

Wash all parts in a cleaning solvent. Check that the bore in the plug is clear.

9–164. Inspection and Repair

a. Check the plug assembly (9, fig. 9–40) and the bore of the body for pits, scratches, and excessive wear. Also check the fit of the plug in the body. If either part appears defective, use a new indicator shutoff valve as repairs to these parts are not practical.

b. Inspect the metal parts for breaks, cracks, or other damage..

c. Select a new packing (3) and fiber bonnet washer (5).

9–165. Reassembly

a. Lubricate the valve parts with grease conforming to military specification MIL–G–6032.

b. Reassemble the indicator shutoff valve in the reverse of the numerical sequence as illustrated on figure 9–40. Leave the screw (1) and handle (2) disassembled.

c. Tighten the body cap (4) to 150 to 200 inch pounds torque.

9–166. Leakage Test

a. Connect the shutoff valve to an air pressure source of approximately 50 psi.

b. With the valve handle in the closed position, use soap suds to check for leakage around the stem and body cap and at the open port.

c. Leakage at any point should not exceed a one-inch soap bubble in one second. Leakage at the stem indicates defective packing. Leakage between the body cap and body indicates a defective bonnet washer. Leakage at the port indicates a defective plug and/or body.

9–167. Installation

Install the indicator shutoff valve in the reverse of the removal procedure.

Section XXIV. AUTOMATIC TOWING HOSE COUPLING ASSEMBLY

9–168. General

a. The automatic towing coupling assembly is used to connect the air lin of a towing vehicle to the air lines of a disabled ditcher that is to be towed. One of the coupling assemblies connects to the front reservoir and can be used to pressurize the entire air system. The other coupling assembly connects only to the service brake lines and must receive an air supply controlled by a brake valve on the towing vehicle.

b. When two coupling assemblies are connected together, the flange of the coupling (5, fig. 9–41) of one coupling assembly fits under the lock arm (3) of the other assembly. This puts pressure on two rubber packings (4) to form an air tight seal. The spring steel cover (2) provides a sufficient pressure on the packing to exclude foreign matter when the assembly is not in use.

9–169. Removal

Remove the automatic towing hose coupling assembly according to TM 5–3805–240–12.

9–170. Disassembly

a. Before disassembly, check the fit of the cover (2, fig. 9–41) over the packing (4). If the cover appears damaged or lacks spring tension, discard the cover when it is removed.

b. Disassemble the coupling assembly in the numerical sequence as illustrated on figure 9–41. Use a screwdriver to pry the packing out of the body and discard the packing.

9–171. Cleaning

Clean all parts in cleaning solvent. Pay particular attention to the groove into which the flange of the packing fits. This groove must be scraped thoroughly clean for an air tight fit.

9–172. Inspection and Repair

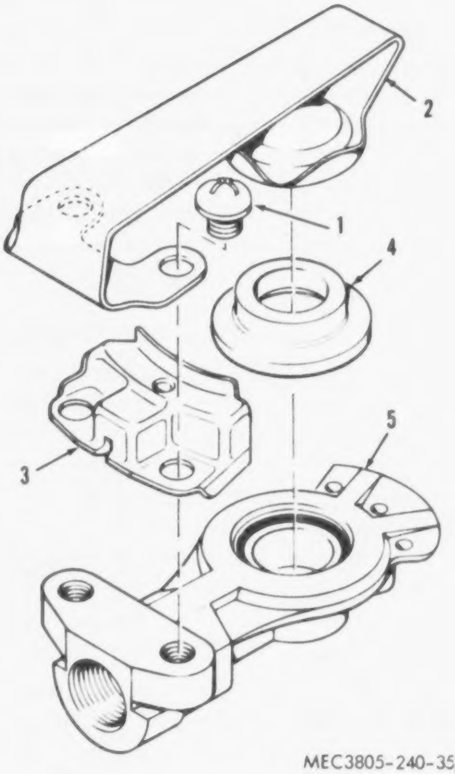
Inspect parts for cracks, breaks, and excessive wear. Replace parts as necessary.

9–173. Reassembly

a. Partially collapse the packing (4, fig. 9–41) with the fingers and enter one side of the packing flange in the groove of the coupling (5).

b. Use a blunt-nose screwdriver to finish pushing the packing place. Check that the packing is flat and not twisted or bulged at any point.

c. Position the lock arm (3) and cover (2) and secure with the screws and lockwashers (1).



MEC3805-240-35/9-41

1 Screw, assembled washer, cross recess round head, 5/16–18 (2 rqr)
2 Cover, automatic coupling
3 Arm, lock
4 Packing, preformed
5 Coupling, automatic

Figure 9–41. Automatic towing hose coupling assembly, exploded view.

9–174. Leakage Test

Note. The coupling assembly can be tested for leakage if a second coupling assembly and an air pressure source are available.

a. Connect the two coupling assemblies. Plug one coupling assembly with a 1/2 inch NPT pipe plug. Connect an air pressure source not exceeding 150 psi to the second coupling assembly.

b. Apply soap suds to the coupling assemblies. Leakage at any point should not exceed a one inch soap bubble in one second.

9–175. Installation

Install the automatic coupling assembly according to TM 5–3805–240–12).

Section XXV. HOSE COUPLING SHUT-OFF COCK

9–176. General

A hose coupling shut-off cock (fig. 9–42) is located in the air line to each of the two automatic towing hose coupling assemblies. The shut-off cocks are used to close off the air lines when the coupling assemblies are not connected.

9-177. Removal

Remove the hose coupling shut-off cock according to TM 5-3805-240-12.

9-178. Disassembly

Disassemble the hose coupling shut-off cock in the numerical sequence as illustrated on figure 9-42.

9-179. Cleaning

Wash all parts in a cleaning solvent. Check that air passages are clear of foreign material.

9-180. Inspection and Repair

a. Inspect the stem (5, fig. 9-42) and the facing surface of the body. A slight scoring of the stem or body can be corrected by grinding with a grade 400 grinding compound. If scoring is excessive, use a new shut-off cock as extensive repairs are not practical.

b. Inspect all parts for breaks, cracks or other damage and replace if necessary. Replace the spring if it has lost its tension.

Note. If the body or stem require replacement, use a new shut-off cock.

9-181. Reassembly

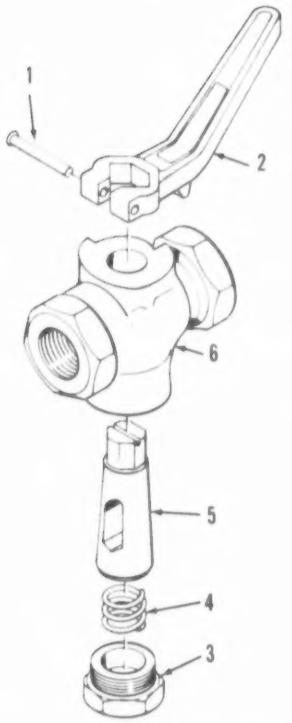
a. Lubricate the stem (5, fig. 9-42) with a light application of good grade cup grease.

b. Reassemble the shutoff cock in the reverse of the numerical sequence as illustrated on figure 9-42.

9-182. Leakage Test

a. Connect an air pressure source of approximately 115 psi to one port of the shut-off cock.

b. With the cock closed, use soap suds to check for leakage at the top and bottom and also at the open port. Leakage at any point should not exceed a one inch soap bubble in one second.



MEC3805-240-35/9-42

1	Rivet, button head	4	Spring, stem
2	Handle, shut-off	5	Stem, cock shut-off
3	Retainer, spring	6	Body, cock shut-off

Figure 9-42. Hose coupling shut-off cock, exploded view.

c. Any leakage indicates a defective seating of the stem in the body. The parts should be reground or a new shut-off cock should be used.

9-183. Installation

Install the hose coupling shut-off cock according to TM 5-3805-240-12.

CHAPTER 10

PROPELLER AND STEERING SHAFT REPAIR INSTRUCTIONS

Section I. DESCRIPTION

10–1. General

This chapter covers the repair of the two types of shafts found in the ditching machine.

10–2. Bearing Cap Construction

a. Figure 10–1 illustrates bearing cap construction. The universal bearing races are secured in place by means of caps which are bolted securely onto the yokes. The bolts holding the bearing cap are secured by a tabbed locking strap.

b. Each bearing is slotted at the outer end to receive a boss, which is stamped into each bearing cap. Four bearings are installed on each journal and are pressed into the yokes.

c. The sleeve shaft is internally splined to mate with the external splines of the slip tube shaft. A cork washer and dust cap are installed at the inner end of the slip shaft to act as a lubricant seal.

10–3. Snap Ring Construction

a. The shaft essentially consists of a hollow tube with external splines, coupled with a sleeve having engaging internal splines, and universal-joint support-yokes at each end (fig. 10–2).

b. Its construction is similar to the bearing-cap-construction shaft, except that the journals are secured with snap rings.

Section II. TRANSFER CASE-TO-REAR DIFFERENTIAL PROPELLER SHAFT ASSEMBLY

10–4. General

The transfer case-to-rear differential propeller shaft is of bearing cap construction. Its function is to transmit power from the transfer case to the rear axle differential.

10–5. Removal

Using an appropriate support sling or cradle jack, remove shaft (para 2–42).

10–6. Disassembly

Disassemble in accordance with TM 9–8621.

10–7. Cleaning, Inspection and Repair

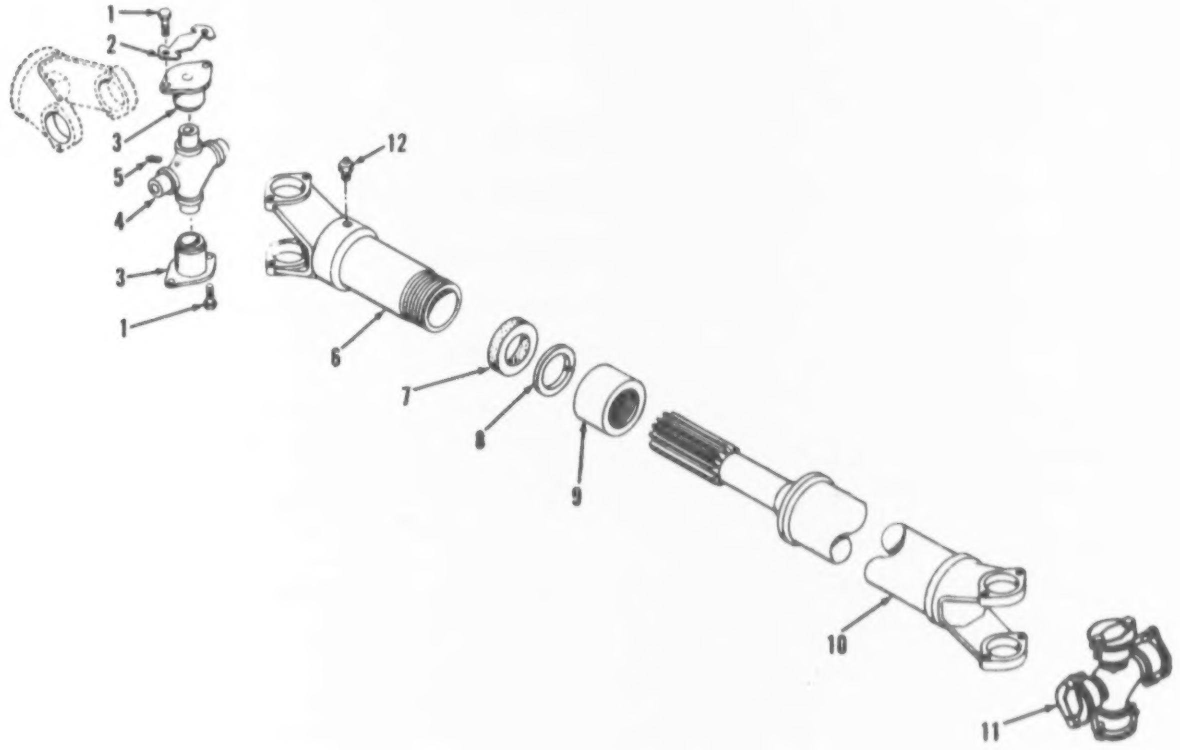
Clean, inspect and repair in accordance with TM 9–8621.

10–8. Reassembly

Reassemble in accordance with TM 9–8621.

10–9. Installation

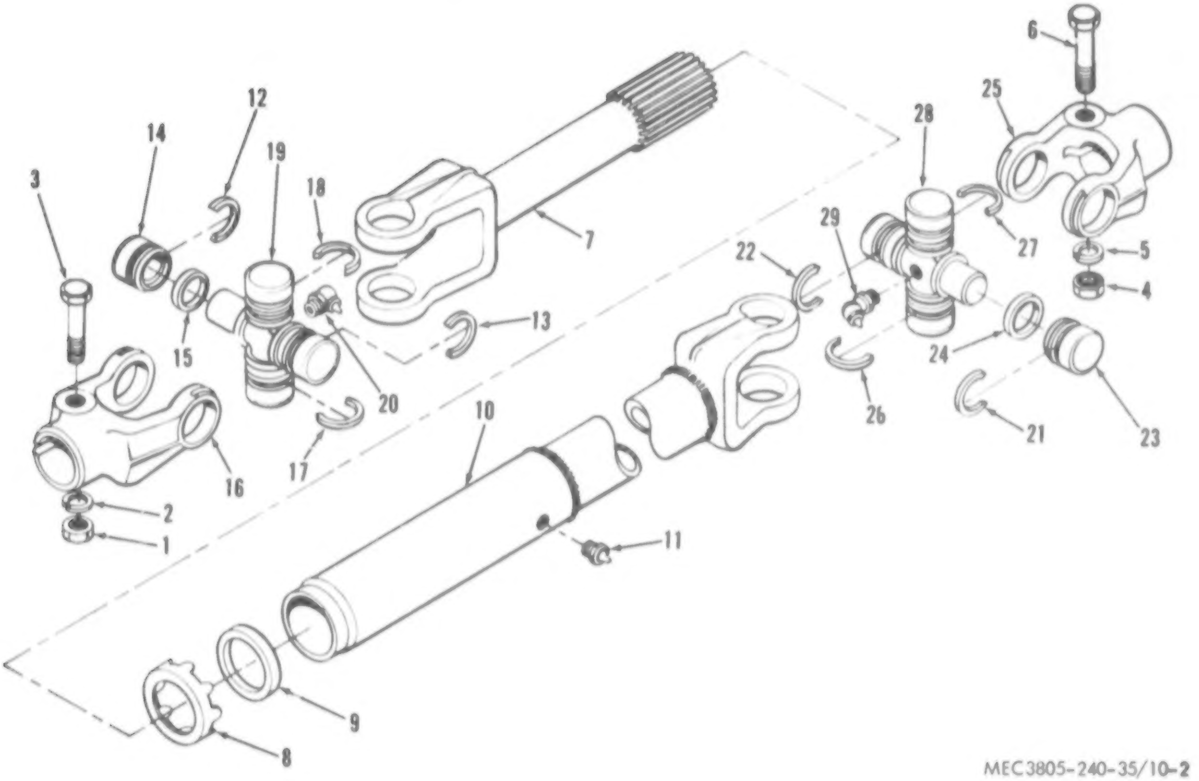
Refer to paragraph 2–42 and install shaft.



MEC3805-240-35/10-1

1	Screw (2 rqr)	5	Fitting, grease	9	Cap, dust
2	Strap, lock	6	Yoke	10	Shaft assembly
3	Race, bearing subassembly	7	Washer, cork	11	Journal assembly
4	Journal	8	Washer, steel	12	Fitting, grease

Figure 10-1. Propeller shaft assembly, exploded view.



MEC3805-240-35/10-2

1	Nut
2	Lockwasher
3	Bolt
4	Nut
5	Lockwasher
6	Bolt
7	Yoke, splined
8	Cap, dust
9	Washer, felt
10	Shaft assembly
11	Fitting, grease
12	Snap ring
13	Snap ring
14	Bushing (4 rqr)
15	Washer, cork (4 rqr)
16	Yoke
17	Snap ring
18	Snap ring
19	Cross
20	Fitting, grease
21	Snap ring
22	Snap ring
23	Bushing (4 rqr)
24	Washer, cork (4 rqr)
25	Yoke
26	Snap ring
27	Snap ring
28	Cross
29	Fitting, grease

Figure 10-2. Steering shaft assembly, exploded view.

Section III. TRANSFER CASE-TO-FRONT DIFFERENTIAL PROPELLER SHAFT ASSEMBLY

10-10. General

The transfer case-to-front differential propeller shaft is of bearing cap construction. Its function is to transmit power from the transfer case to the front axle differential.

10-11. Removal

Using an appropriate support sling or cradle jack remove shaft (para 2-42).

10-12. Disassembly

Disassemble in accordance with TM 9-8621.

10-13. Cleaning, Inspection and Repair

Clean, inspect and repair in accordance with TM 9-8621.

10-14. Reassembly

Reassemble in accordance with TM 9-8621.

10-15. Installation

Refer to paragraph 2-42 and install shaft.

Section IV. TRANSFER CASE-TO-SPROCKET-DRIVE PROPELLER SHAFT ASSEMBLY

10-16. General

The transfer case-to-sprocket-drive propeller shaft assembly is of bearing cap construction. Its function is to transmit power from the transfer case to the sprocket drive assembly.

10-17. Removal

Using an appropriate support sling or cradle jack, remove shaft (para 2-42).

10-18. Disassembly

Disassemble in accordance with TM 9-8621.

10-19. Cleaning, Inspection and Repair

Clean, inspect and repair in accordance with TM 9-8621.

10-20. Reassembly

Reassemble in accordance with TM 9-8621.

10-21. Installation

Refer to paragraph 2-42 and install shaft.

Section V. TRANSMISSION-TO-TRANSFER CASE PROPELLER SHAFT ASSEMBLY

10-22. General

The transmission-to-transfer case propeller shaft is of bearing cap construction. Its function is to transmit power from the transmission to the transfer case.

10-23. Removal

Remove shaft (para 2-42).

10-24. Disassembly

Disassemble in accordance with TM 9-8621.

10-25. Cleaning, Inspection and Repair

Clean, inspect and repair in accordance with TM 9-8621.

10-26. Reassembly

Reassemble in accordance with TM 9-8621.

10-27. Installation

Refer to paragraph 2-42 and install shaft.

Section VI. STEERING GEAR BOX-TO-POWER STEERING UNIT DRIVE SHAFT ASSEMBLY

10-28. General

The steering gear box-to-power steering unit drive shaft is of snap ring construction. Its function is to transmit manually applied turning force to the power steering gear assembly.

10-29. Removal

Remove shaft (para 2-43).

10-30. Disassembly

Disassemble in accordance with TM 9-8621.

10-31. Cleaning, Inspection and Repair

Clean, inspect and repair in accordance with TM 9-8621.

10-32. Reassembly

Reassemble in accordance with TM 9-8621.

10-33. Installation

Refer to paragraph 2-43 and install shaft.

CHAPTER 11

ELECTRICAL SYSTEM

11-1. General

The electrical components of the ditcher are connected by wires which are gathered and supplied as harnesses. Refer to figure 11-1.

11-2. Testing

a. Check wires visually for breaks and frayed insulation.

b. Use a volt-ohmmeter to test for voltage at ends of wires suspected of having breaks or short circuits. If available, a sensitive ohmmeter may reveal partial short circuits.

11-3. Removal

a. Remove wiring harnesses only if necessary.

b. Refer to figure 11-1 and disconnect wires at connectors and remove clamps to remove individual harnesses.

c. Repair individual components on the ditcher when most wires have good insulation.

11-4. Repairs

a. Clean corroded electrical contacts. Replace defective connectors.

b. Repair broken wires with badly frayed insulation using connector shown in figure 11-2.

## 11-5. Installation

a. Refer to figure 11-1 and tape individual harnesses into position on ditcher and connect wires at connectors.

b. Shift harness as necessary to make connections and install clamps.

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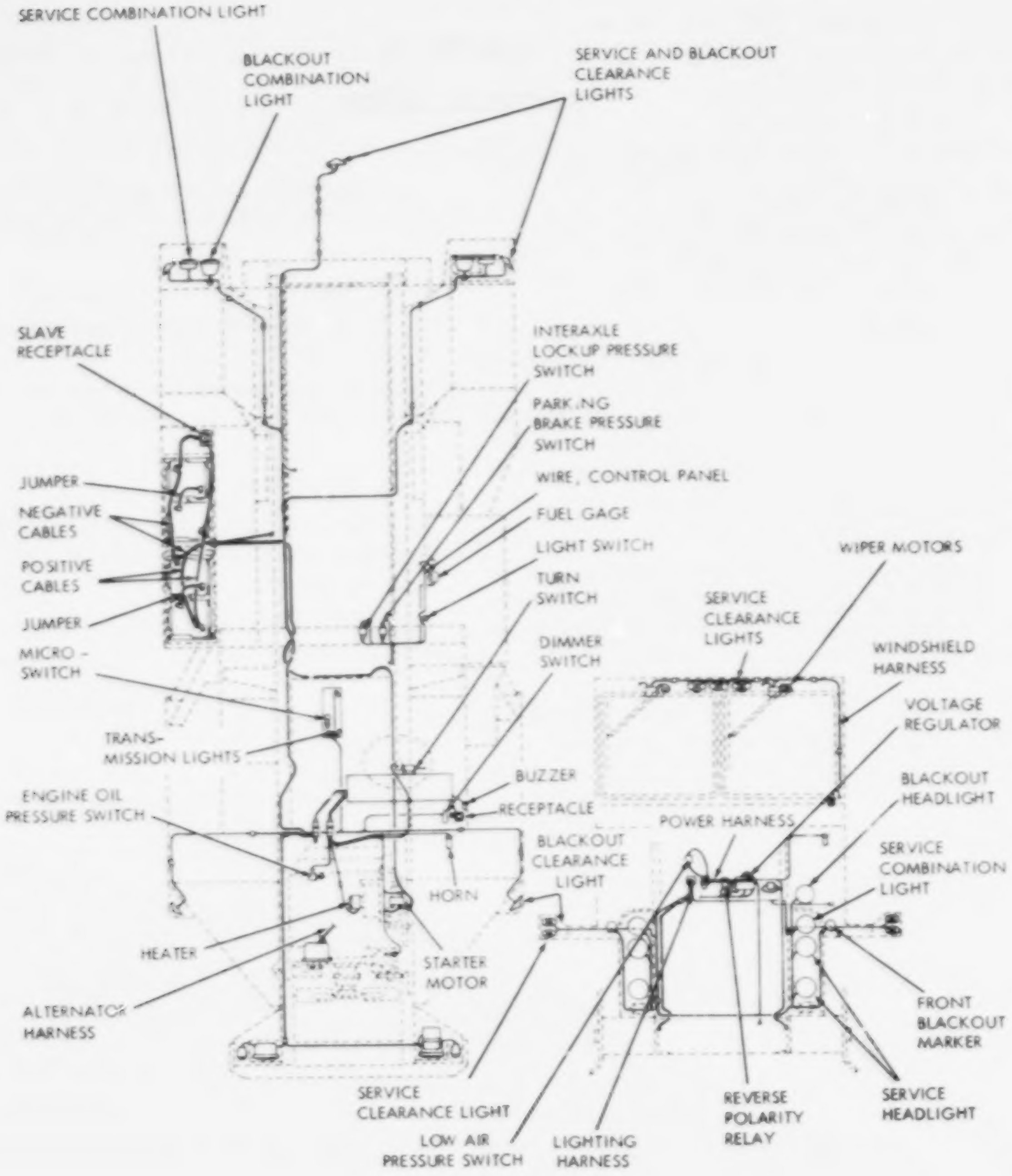
SERVICE COMBINATION LIGHT
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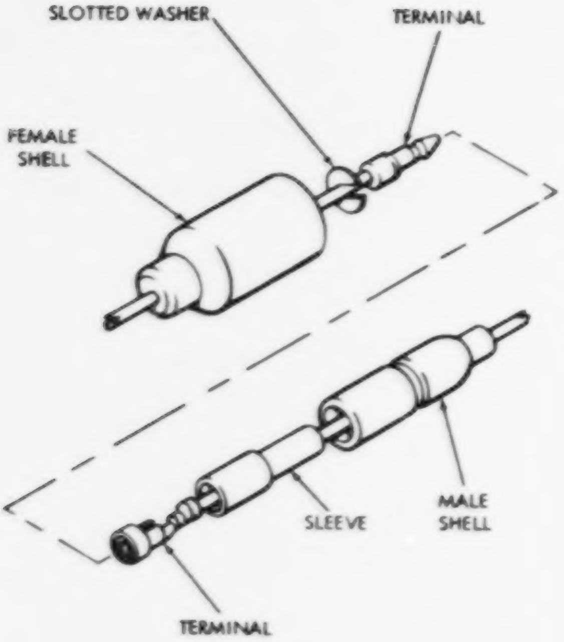
SERVICE AND BLACKOUT CLEARANCE LIGHTS
SLAVE RECEPTACLE
INTERAXLE LOCKUP PRESSURE SWITCH
PARKING BRAKE PRESSURE SWITCH
WIRE, CONTROL PANEL
FUEL GAGE
LIGHT SWITCH
TURN SWITCH
JUMPER
NEGATIVE CABLES
POSITIVE CABLES
JUMPER
MICRO - SWITCH
WIPER MOTORS
SERVICE CLEARANCE LIGHTS
DIMMER SWITCH
WINDSHIELD HARNESS
VOLTAGE REGULATOR
TRANS- MISSION LIGHTS
BUZZER
RECEPTACLE
BLACKOUT HEADLIGHT
ENGINE OIL PRESSURE SWITCH
POWER HARNESS
BLACKOUT CLEARANCE LIGHT
SERVICE COMBINATION LIGHT
HORN
HEATER
STARTER MOTOR
ALTERNATOR HARNESS
FRONT BLACKOUT MARKER
SERVICE CLEARANCE LIGHT
REVERSE POLARITY RELAY
SERVICE HEADLIGHT
LOW AIR PRESSURE SWITCH
LIGHTING HARNESS

MEC3805-240-35/11-1

Figure 11-1. Electrical wiring harnesses.


SLOTTED WASHER
TERMINAL
FEMALE SHELL
SLEEVE
MALE SHELL
TERMINAL

MEC3805-240-35/11-2

Figure 11-2. Electrical connector.

CHAPTER 12

FUEL TANK REPAIR INSTRUCTIONS

12-1. General

The fuel tank is an aluminum tank having 3/8 inch feed line, return line, and drain cock connections. Tank capacity is 100 gallons with a recommended air volume of approximately 3 cubic feet. The top of the tank is equipped with diamond deck tread and a chair support to form part of the remote operator's station during the ditching operation.

12-2. Removal

Remove fuel tank (TM 5-3805-240-12).

Warning: **Before attempting repair, clean tank thoroughly as safety precaution against explosion of fumes remaining in the tank.**

12-3. Cleaning

a. Fill tank with an alkaline cleaner (Q.M.C. Tentative Specifications ES-No. 542) and then flush out with steam. Keep fittings open to avoid buildup of excessive steam pressure.

b. Drain all sediment, water, and other foreign matter.

12-4. Testing

a. Position tank so all external areas can be observed.

b. Plug all openings except filler neck to make them water tight.

c. Fill tank with water and dry outside of tank.

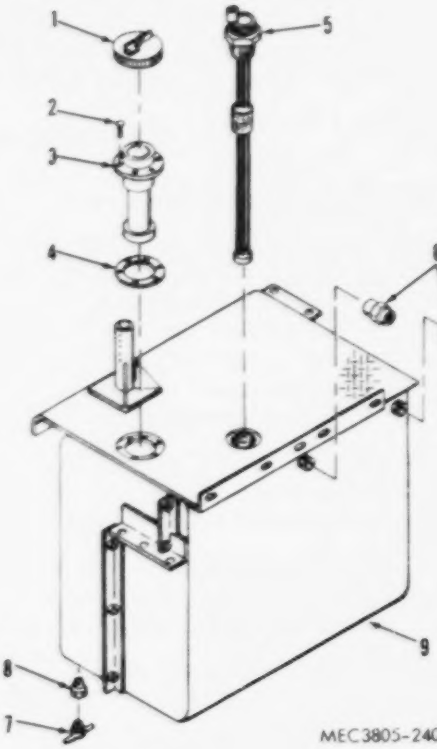
d. Insert end of air hose in filler neck opening and cover rest of opening with hand. Apply air pressure for several minutes.

e. Inspect for any leakage or moist areas, particularly near seams and fittings. Mark leaking seam areas.

f. After determining extent of repair necessary, remove plugs and drain tank.

12-5. Disassembly

Disassemble fuel tank in the numerical sequence as illustrated on figure 12-1.



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1	Filler cap
2	Rivet (6 rqr)
3	Filler neck assembly
4	Cork gasket
5	Fuel level indicator unit
6	Pipe coupling (2 rqr)
7	Drain cock
8	Pipe reducer
9	Tank assembly

Figure 12-1. Fuel tank assembly, exploded view.

12-6. Inspection and Repair

a. Inspect all removable components. Replace cork gasket (4, fig. 12-1). Inspect pipe threads for damage and replace parts as necessary.

b. Repair leaks as necessary using solder and soldering copper. Refer to TM 10-450.

***Warning:* Do not use a torch when repairing a fuel tank. Use a soldering copper.**

c. Inspect fuel level indicator unit and replace if necessary. Refer to TM 5-3805-240-12.

12-7. Reassembly

Reassemble fuel tank in reverse of the numerical sequence as illustrated on figure 12-1.

12-8. Installation

Install fuel tank (TM 5-3805-240-12).

CHAPTER 13

CAB AND DIGGING STATION REPAIR INSTRUCTIONS

Section I. INTRODUCTION

13-1. General

This section describes, locates and illustrates those items which are part of the operator's compartment installation. They consist of all controls and linkages provided for the operation of the vehicle, as well as seat assemblies and the heater and defroster.

Section II. HEATER AND DEFROSTER

13-2. Duct and Control Assemblies

a. General. The ducts distribute or recirculate fresh or heated air to the personnel cab. The controls regulate the flow of air.

b. Removal and Disassembly. Remove and disassemble the heater and defroster duct and control assemblies in the numerical sequence as illustrated on figure 13-1.

c. Cleaning, Inspection, and Repair.

(1) Clean all metal parts with an approved solvent or by the live steam-cleaning method.

***Caution:* Do not use caustic soda solution for steam cleaning.**

(2) Dry metal parts, using compressed air. Coat steam-cleaned bare metal parts with lubricating oil immediately after drying.

(3) Inspect threaded parts for damaged threads and chase with correct size of tap or replace damaged parts as necessary.

(4) Inspect sheet metal for damaged paint and other defects and repair or replace (para 15-4).

d. Reassembly and Installation. Reassemble and install the heater and defroster duct and control assemblies reverse of the numerical sequence as illustrated on figure 13-1.

13-3. Heater and Defroster Assembly

a. General. The heater supplies heated or unheated fresh or recirculated air to the personnel cab and to the windshield defrosters. Heat is supplied by hot water flowing through hoses from the engine radiator to the coils of the heater unit. An impeller powered by a 24-volt motor mounted on the blower unit circulates air.

b. Removal and Disassembly. Remove and disassemble the heater and defroster assembly in the numerical sequence as illustrated on figure 13-2.

c. Cleaning, Inspection, and Repair.

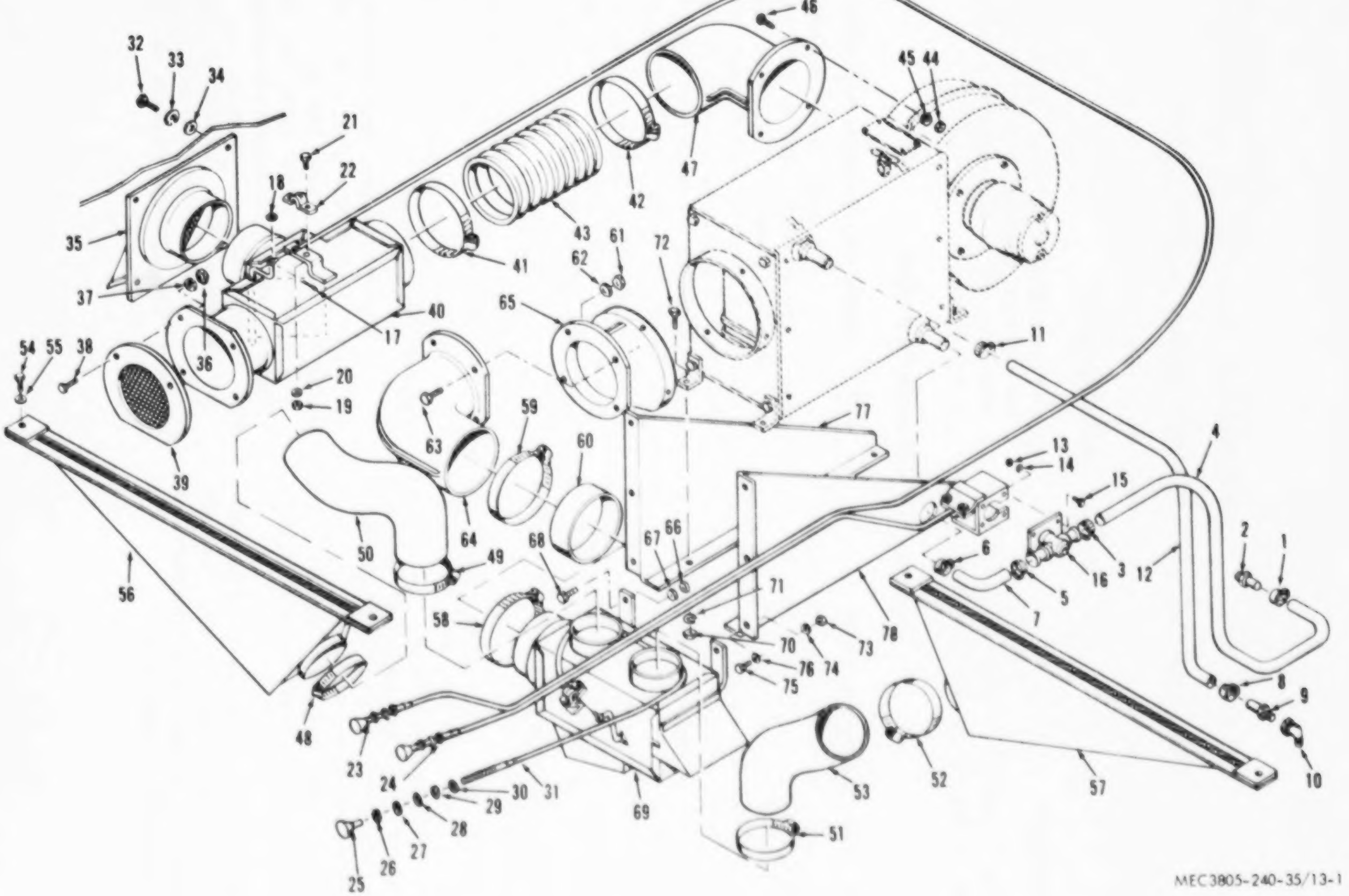
(1) Clean all metal parts with an approved solvent or by the live steam-cleaning method.

***Caution:* Do not use caustic soda solution for steam cleaning.**

(2) Dry metal parts using compressed air. Coat steam-cleaned bare metal parts with lubricating oil immediately after drying.

(3) Inspect threaded parts for damaged threads and chase with correct size of tap or replace damaged parts as necessary.

d. Reassembly and Installation Reasemble and install the heater and defroster assembly in reverse of the numerical sequence as illustrated on figure 13-2.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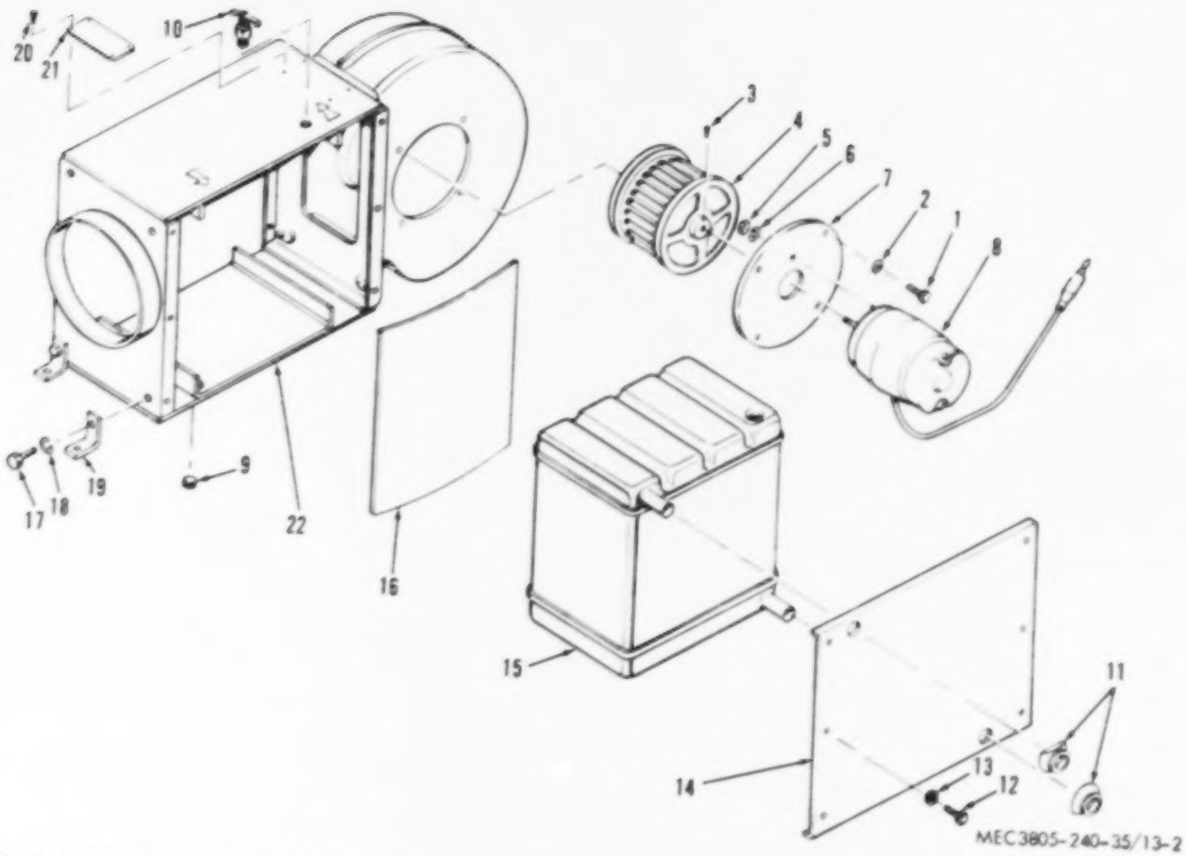
MEC3805-240-35/13-1

1 Clamp, hose
2 Adapter
3 Clamp, hose
4 Hose
5 Clamp, hose
6 Clamp, hose

Figure 13-1. Heater ducts and controls, exploded view.

7 Hose
8 Clamp,hose
9 Adapter
10 Elbow, 90°
8 Clamp, hose
12 Hose
13 Nut, plain, hex: jam, No. 10-32 (4 rqr)
14 Washer, lock: No. 10
15 Screw, cap, hex hd: No. 10-32 x 5/8 in. (4 rqr)
16 Valve
17 Pin: 1/16 x 1/2 (3 rqr)
18 Washer, flat: No. 10
19 Nut, plain, hex: No. 10-32 (6 rqr)
20 Washer, lock: No. 10 (6 rqr)
21 Screw, cap, hex hd: No. 10-32 x 1/2 in. (6 rqr)
22 Clamp (3 rqr)
23 Control assembly, push-pull
24 Control assembly, push-pull
25 Knob
26 Nut, plain, hex: jam, 1/4-28
27 Packing nut: 3/8-24
28 Sleeve
29 Washer, flat: 3/8 in.
30 Nut, plain, hex: jam, 3/8-24
31 Cable assembly
32 Screw, cap, hex hd: 1/4-20 x 1/2 in. (4 rqr)
33 Washer, lock: 1/4 in. (4 rqr)
34 Washer, flat: 1/4 in. (4 rqr)
35 Air intake assembly
36 Nut, plain, hex: 1/4-20 (4 rqr)
37 Washer, lock: 1/4 in. (4 rqr)
38 Screw, cap, hex hd: 1/4-20 x 7/8 in. (4 rqr)
39 Screen
40 Air intake diverter
41 Clamp, hose
42 Clamp, hose
43 Hose
44 Nut, plain, hex: 1/4-20 (4 rqr)
45 Washer, lock: 1/4 in. (4 rqr)
46 Screw, cap, hex hd: 1/4-20 x 7/8 in. (4 rqr)
47 Elbow
48 Clamp, hose
49 Clamp, hose
50 Hose
51 Clamp, hose
52 Clamp, hose
53 Hose
54 Screw, cap, hex hd: 1/4-20 1/2 in. (4 rqr)
55 Washer, lock: 1/4 in. (4 rqr)
56 Outlet defrost
57 Outlet defrost
58 Clamp, hose
59 Clamp, hose
60 hose
61 Nut, plain, hex: 1/4-20 (4 rqr)
62 Washer, lock: 1/4 in. (4 rqr)
63 Screw, cap, hex hd: 1/4-20 x 7/8 in. (4 rqr)
64 Elbow
65 Adapter assembly
66 Nut, plain, hex: 1/4-20 (4 rqr)
67 Washer, lock: 1/4 in. (4 rqr)
68 Screw, cap, hex hd: 1/4-20 x 7/8 in. (4 rqr)
69 Diverter assembly
70 Nut, plain, hex: 5/16-18 (4 rqr)
71 Washer, lock: 5/16 in. (4 rqr)
72 Screw, cap, hex hd: 5/16-18 x 3/4 in. (4 rqr)
73 Nut, plain, hex: 3/8-16 (6 rqr)
74 Washer, lock: 3/8 in. (6 rqr)
75 Screw, cap, Hex hd: 3/8-16 x 1 in. (6 rqr)
76 Shim (as rqr)
77 Bracket, L.H.
78 Bracket, R.H.

Figure 13-1—Continued



1	Screw, machine: 1/4–20 x 3/8 in. (4 rqr)
2	Washer, lock: internal tooth, 1/4 in. (4 rqr)
3	Setscrew
4	Impeller
5	Nut, plain, hex: No. 8–32 (2 rqr)
6	Washer, lock: No. 8 (2 rqr)
7	Flange
8	Motor, 24V
9	Plug, pipe
10	Plug, vent
11	Grommet
12	Screw, machine: No. 10–24 x 3/8 in. (6 rqr)
13	Washer, lock: internal tooth, No. 19 (6 rqr)
14	Cover
15	Core and tank assembly
16	Spacer, side core
17	Screw, cap, hex hd: 5/16–18 x 1/2 in. (4 rqr)
18	Washer, lock: 5/16 in. (4 rqr)
19	Bracket, mounting
20	Screw, machine, self tapping: No. 4 x 1/4 in. (4 rqr)
21	Nameplate
22	Housing assembly

Figure 13–2. Heater and defroster assembly, exploded view.

Section III. CONTROLS

13–4. Crowd Drive Control Assembly

a. General. The crowd drive control assembly is mounted on the floor of the cab compartment of the left of the operator's seat. It is connected by linkage to the shift rod of the transfer case. It serves to shift the gears of the transfer case to either the digging mode or the road travel mode.

b. Removal and Disassembly. Remove and disassemble the crowd drive control lever and linkage in numerical sequence as illustrated on figure 13–3.

c. Cleaning, Inspection, and Repair.

(1) Clean all metal parts with an approved solvent or by the live steam-cleaning method.

***Caution:* Do not use caustic soda solution for steam cleaning.**

(2) Dry metal parts, using compressed air. Coat steam-cleaned bare metal parts with lubricating oil immediately after drying.

(3) Inspect threaded parts for damaged threads and chase with correct size of tap or replace damaged parts as necessary.

d. Reassembly and Installation. Reassemble and install the crowd drive control assembly in reverse of the numerical sequence as illustrated on figure 13-3.

Note. For adjustment instructions, refer to TM 5-3805-240-12.

13-5. Crowd and Conveyor Linkage Assemblies

a. General. The crowd and conveyor linkages connect the crowd and conveyor speed controls to respectively, the crowd drive and the conveyor belt drive pumps. They are a combination of rods, clevis-pins, clevis and ball joints.

b. Removal and Disassembly. Remove linkages and disassemble in numerical sequence as illustrated on figure 13-4.

c. Cleaning, Inspection, and Repair.

(1) Clean all metal parts with an approved solvent or by the live steam-cleaning method.

Caution: **Do not use caustic soda solution for steam cleaning.**

(2) Dry metal parts, using compressed air. Coat steam-cleaned bare metal parts with lubricating oil immediately after drying.

(3) Inspect threaded parts for damaged threads and chase with correct size of tap or replace damaged parts as necessary.

d. Reassembly and Installation. Reassemble and install linkages in reverse of the numerical sequence as illustrated on figure 13-4.

Note. For adjustment instructions, refer to TM 5-3805-240-12.

13-6. Crowd and Conveyor Control Assemblies

a. General. The crowd and conveyor controls are mounted at the control station, located at the outside rear of the operator's compartment. They are operated to control the speeds of the crowd and conveyor motors.

b. Removal and Disassembly. Remove and disassemble the crowd and conveyor control assembly in the numerical sequence as illustrated on figure 13-5.

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts with an approved solvent or by the live steam-cleaning method.

Caution: **Do not use caustic soda solution for steam cleaning.**

(2) Dry metal parts, using compressed air. Coat steam-cleaned bare metal parts with lubricating oil immediately after drying.

(3) Inspect threaded parts for damaged threads and chase with correct size of tap or replace damaged parts as necessary.

d. Reassembly and Installation. Reassemble and install the crowd and conveyor control assembly in reverse of the numerical sequence as illustrated on figure 13-5.

Note. After installation, inspect levers (17 and 22) for hood operation or ability to hold position in normal ditching operation. Tighten or loosen brake screw (19) or clamp (1) as necessary.

13-7. Accelerator Pedal and Hand Throttle Control Assembly

a. General. The hand throttle control is located at the digging station of the ditcher. It is used instead of the accelerator pedal to increase engine speed. The accelerator pedal is located on the cab floor. These controls are used to regulate engine speed from either the cab or the digging station.

b. Removal and Disassembly. Remove the accelerator pedal and hand throttle control in numerical sequence as illustrated on figure 13-6.

c. Cleaning, Inspection, and Repair.

(1) Clean all metal parts with an approved solvent or by the live steam-cleaning method.

Caution: **Do not use caustic soda solution for steam cleaning.**

(2) Dry metal parts using compressed air. Coat steam-cleaned bare metal parts with lubricating oil immediately after drying.

(3) Inspect threaded parts for damaged threads and close with correct size of top or replace damaged parts as necessary.

d. Reassembly and Installation. Reassemble and install the accelerator pedal and throttle assembly in reverse of the numerical sequence as illustrated on figure 13-6.

13-8. Engine Shut-off Assembly

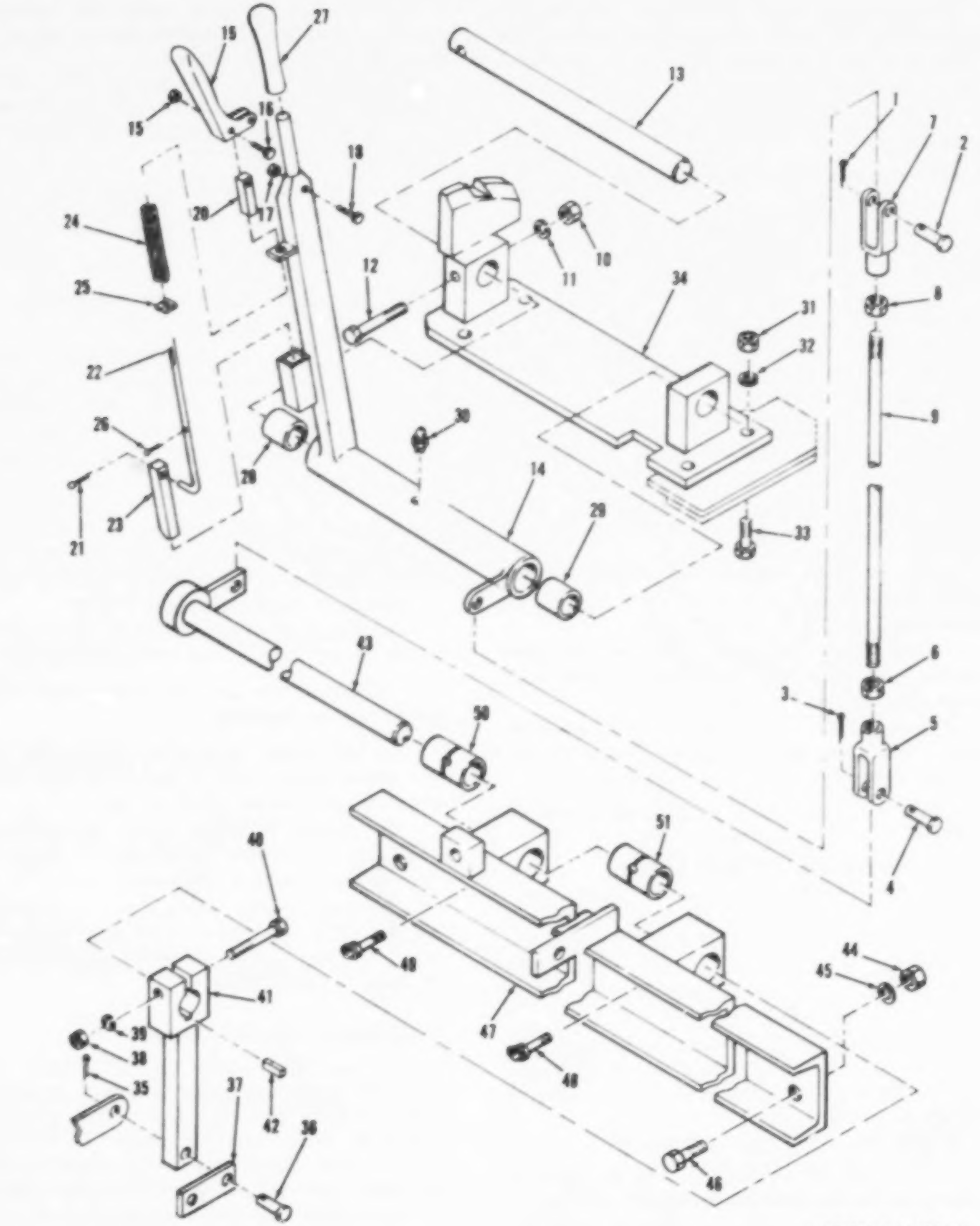
a. General. The engine shut-off control tee handle is mounted on the instrument panel. It is connected by flexible cable to the governor fuel shut-off lever at the engine.

b. Removal and Disassembly. Remove and disassemble the control assembly in the numerical sequence as illustrated on figure 13-7.

c. Cleaning, Inspection, and Repair.

(1) Clean all metal parts with an approved solvent or by the live steam-cleaning method.

Caution: **Do not use caustic soda solution for steam cleaning.**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MEC3805-240-35/13-3

1 Cotter pin
2 Clevis pin
3 Cotter pin
4 Clevis pin
5 Clevis
6 Nut, jam, 3/8-24

Figure 13-3. Crowd drive lever and linkage assembly, exploded view.

7	Clevis
8	Nut, jam, 3/8-24
9	Rod
10	Nut, 1/4-20
11	Washer, lock, 1/4
12	Screw, 1/4-20 x 2 1/2 in.
13	Shaft, lever
14	Lever assembly
15	Nut, jam, 1/4-20
16	Screw, 1/4-20 x 1 in.
17	Nut, jam, 1/4-20
18	Screw, 1/4-20 x 1 in.
19	Pawl lever
20	End Cap
21	Cotter pin
22	Pawl rod
23	Pawl
24	Pawl spring
25	Washer
26	Cotter pin
27	Lever grip
28	Bearing, sleeve
29	Bearing, sleeve
30	Grease fitting
31	Nut, 1/2-13 (4 rqr)
32	Washer, lock, 1/4 in. (4 rqr)
33	Screw, 1/2-13 x 1 1/4 in. (4 rqr)
34	Mounting weldment
35	Cotter pin
36	Clevis pin
37	Link
38	Nut, 1/4-20
39	Washer, lock 1/4 in.
40	Screw, 1/4-20 x 2 1/4 in.
41	Linkage lever
42	Key
43	Linkage shaft
44	Nut, 1/2-13 (4 rqr)
45	Washer, lock, 1/2 in. (2 rqr)
46	Screw, 1/2-13 x 1 1/4 in. 4 rqr)
47	Channel weldment
48	Grease fitting
49	Grease fitting
50	Bearing, sleeve
51	Bearing, sleeve

Figure 13-8—Continued

(2) Dry metal parts, using compressed air. Coat steam-cleaned bare metal parts with lubricating oil immediately after drying.

(3) Inspect threaded parts for damaged threads and chase with correct size of tap or replace damaged parts as necessary.

d. Reassembly and Installation. Reassemble and install the control assembly in reverse of the numerical sequence as illustrated on figure 13-7.

Note. For adjustment instructions, refer to TM 5-3805-240-12.

13-9. Engine Emergency Shutdown Assembly

a. General. The engine emergency shutdown assembly is mounted on the instrument panel to the right of the driver. It is used to cut off the flow of air to the diesel engine in emergencies only to immediately stop the operation of the engine.

b. Removal and Disassembly. Remove and disassemble the engine emergency shutdown assembly in the numerical sequence as illustrated on figure 13-8.

c. Cleaning, Inspection, and Repair.

(1) Clean all metal parts with an approved solvent or by the live steam-cleaning method.

***Caution:* Do not use caustic soda solution for steam cleaning.**

(2) Dry metal parts using compressed air. Coat steam-cleaned bare metal parts with lubricating oil immediately after drying.

(3) Inspect threaded parts for damaged threads and chase with correct size of tap or replace damaged parts as necessary.

d. Reassembly and Installation. Reassemble and install the engine emergency shutdown assembly in reverse of the numerical sequence as illustrated on figure 13-8.

13-10. Parking Brake Control Assembly

a. General. The control assembly for the parking brake air valve is mounted on the floor of the cab to the left rear of the driver. It can also be operated either from the digging station or the cab.

b. Removal and Disassembly. Remove and disassemble the parking brake control assembly in the numerical sequence as illustrated on figure 13-9.

c. Cleaning, Inspection, and Repair.

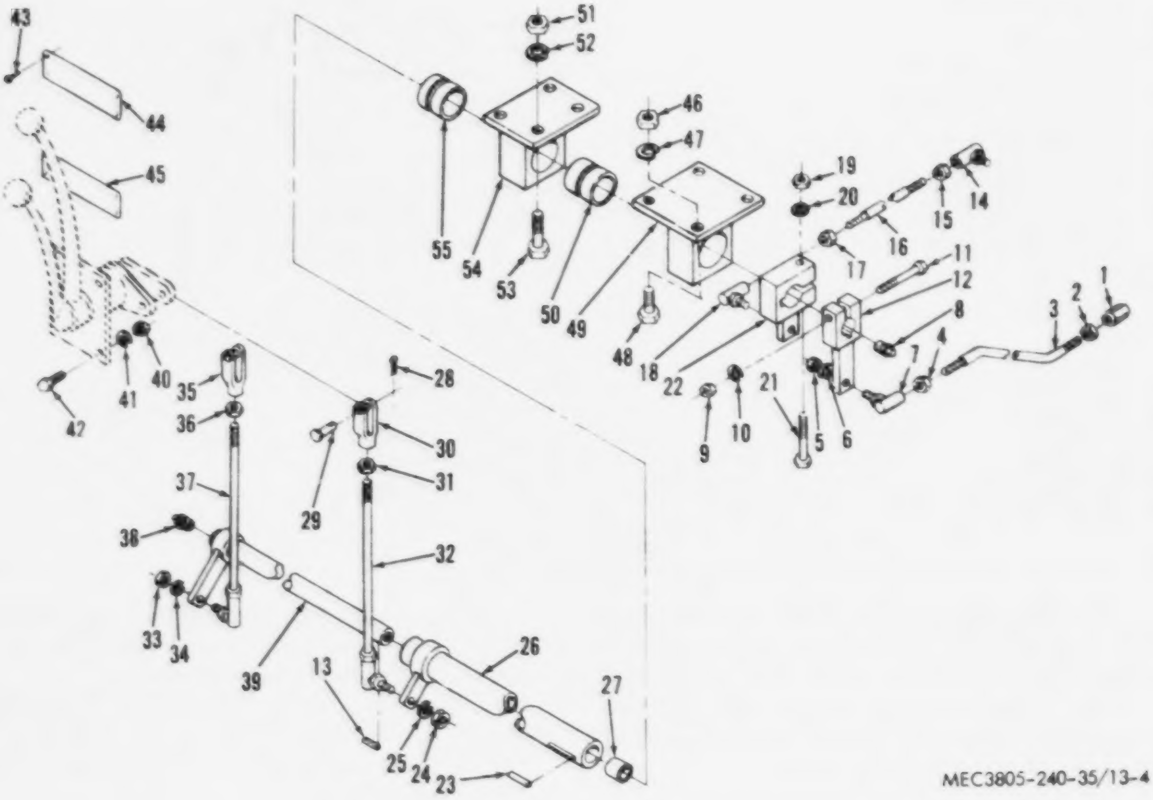
(1) Clean all metal parts with an approved solvent or by the live steam-cleaning method.

***Caution:* Do not use caustic soda solution for steam cleaning.**

(2) Dry metal parts, using compressed air. Coat steam-cleaned bare metal parts with lubricating oil immediately after drying.

(3) Inspect threaded parts for damaged threads and chase with correct size of tap or replace damaged parts as necessary.

d. Reassembly and Installation. Reassemble and install the parking brake control assembly in reverse of the numerical sequence as illustrated on figure 13-9.



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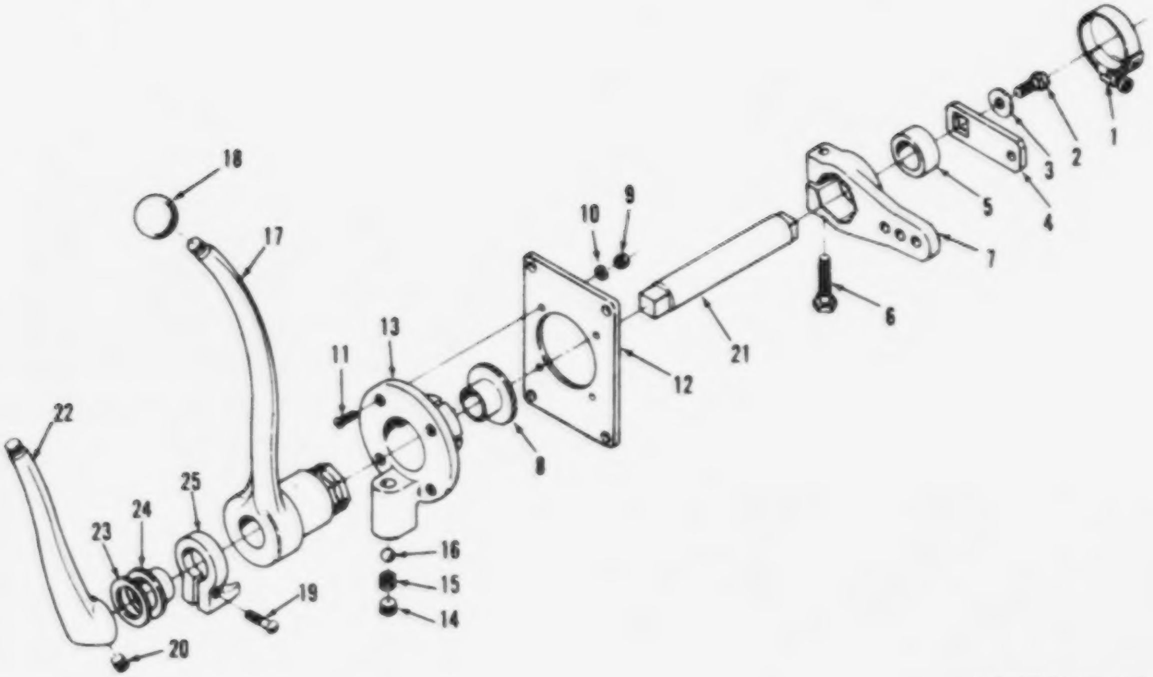
1 Connector
2 Nut, plain, hex: jam, 5/16-24
3 Connector rod weldment
4 Nut, plain, hex: jam, 5/16-24
5 Nut, plain, hex: 5/16-24
6 Washer, lock—5/16 in.
7 Ball joint: type R, 5/16
8 Fitting, lube
9 Nut, plain, hex: 1/4-20
10 Washer, lock: 1/4 in.
11 Screw, cap, hex hd: 1/4-20 x 1 1/2 in.
12 Arm, crowd pump control
13 Key, sq.
14 Ball joint: type R, 5/16
15 Nut, plain, hex: 5/16-24
16 Rod, threaded end
17 Nut, plain, hex, 5/16-24
18 Ball joint: type R, 5/16
19 Nut, plain, hex: 1/4-20
20 Washer, lock: 1/4 in.
21 Screw, cap, hex hd: 1/4-20 x 2 in.
22 Arm, conveyor pump control
23 Key, sq.
24 Nut, plain, hex: 5/16-24
25 Washer, lock: 5/16 in.
26 Lever assembly, outer
27 Bushing
28 Pin, cotter (2 rqr)
29 Pin, clevis (2 rqr)
30 Clevis, thd end
31 Nut, plain, hex: jam, 5/16-24
32 Rod, thd, end
33 Nut, plain, hex: 5/16-24
34 Washer, lock: 5/16 in.
35 Clevis, thd end
36 Nut, plain, hex: 5/16-24
37 Rod, thd end
38 Fitting, lube
39 Lever assembly, inner
40 Nut, plain, hex: 1/4-20 (4 rqr)
41 Washer, lock: 1/4 in. (4 rqr)
42 Screw, cap, hex hd: 1/4-20 x 1/2 in. (4 rqr)
43 Screw, drive: No. 6 (8 rqr)
44 Nameplate, crowd
45 Nameplate, conveyor
46 Nut, plain, hex: 1/2-13 (4 rqr)
47 Washer, lock: 1/2 in. (4 rqr)
48 Screw, cap, hex hd: 1/2-13 x 1 1/4 in. (4 rqr)
49 Bearing block
50 Bushing
51 Nut, plain, hex: 1/2-13 (4 rqr)
52 Washer, lock: 1/2 in. (4 rqr)
53 Screw, cap, hex hd: 1/2-13 x 1 in. (4 rqr)
54 Bearing block
55 Bushing

Figure 13-4. Control linkage assembly for crowd and conveyor pumps, exploded view.



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1	Clamp, hose
2	Screw, cap, hex hd: 1/4-28 x 1/2 in.
3	Washer, flat: 1/4 in.
4	Lever arm
5	Spacer
6	Screw, cap, hex hd: 5/16-18 x 1 1/2 in.
7	Lever
8	Bearing
9	Nut, plain, hex: No. 10-32 (4 rqr)
10	Washer, lock: No. 10 (4 rqr)
11	Screw, mach: No. 10-32 x 5/8 in. (4 rqr)
12	Plate, mtg
13	Housing
14	Plug
15	Spring, tension
16	Ball, bearing
17	Lever assembly
18	Knob (2 rqr)
19	Screw, mach
20	Setscrew
21	Shaft
22	Lever
23	Washer, flat
24	Bushing
25	Brake, external

Figure 13-5. Pump control lever assembly, exploded view.

Note. For adjustment instructions, refer to TM 5-3805-240-12.

13-11. Digging Station Four-Section Valve Control Levers and Linkage

a. General. The four-section valve linkage connects the boom hoist, boom tilt, scraper blade and conveyor shift control levers to the four-section control valve to regulate the digging boom hydraulic cylinders and the conveyor shift motor.

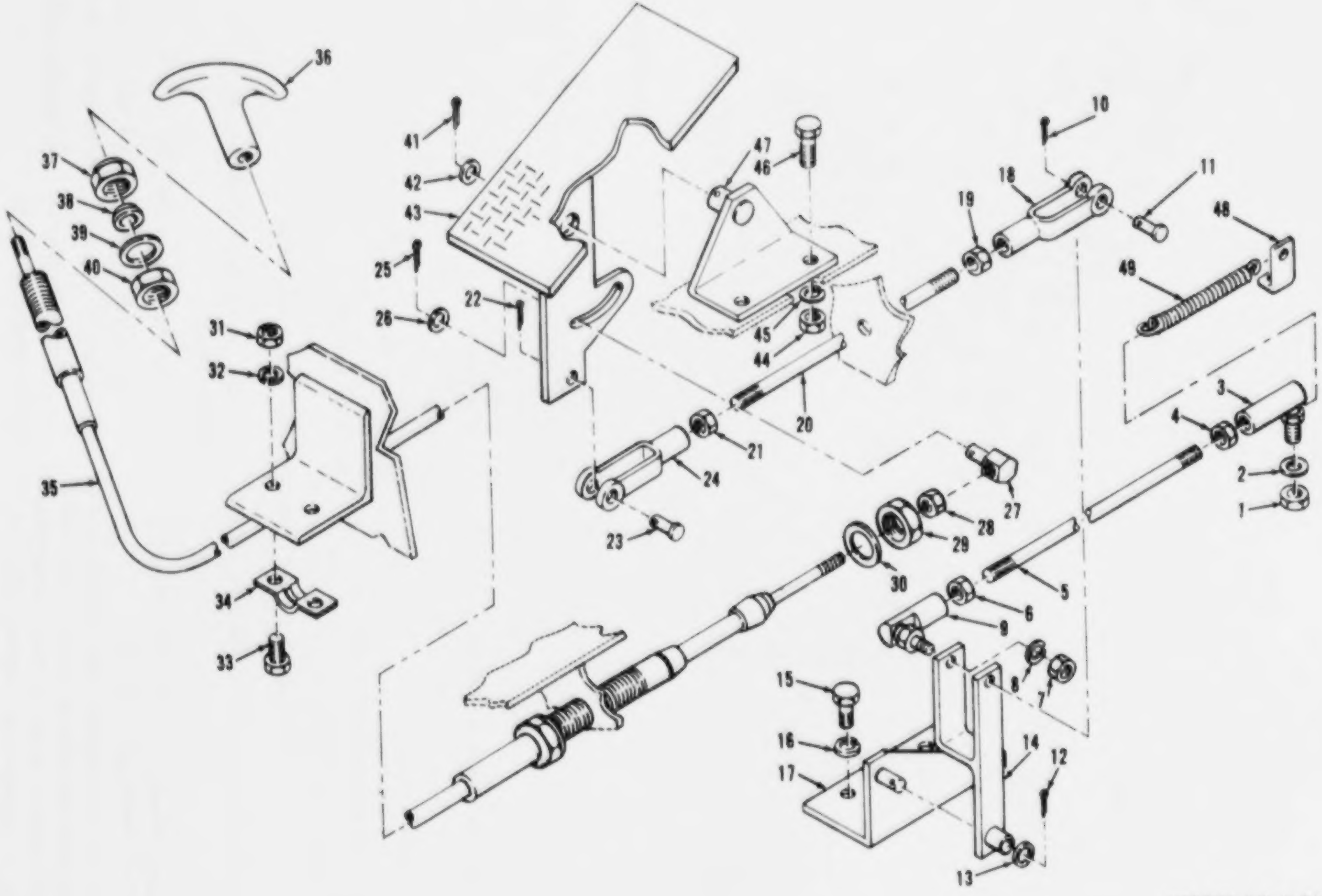
b. Removal and Disassembly. Remove and disassemble the four-section valve control assembly in the numerical sequence as illustrated on figure 13-10.

c. Cleaning, Inspection, and Repair.

(1) Clean all metal parts with an approved solvent or by the live steam-cleaning method.

***Caution:* Do not use caustic soda solution for steam cleaning.**

(2) Dry metal parts, using compressed air. Coat steam-cleaned bare metal parts with lubricating oil immediately after drying.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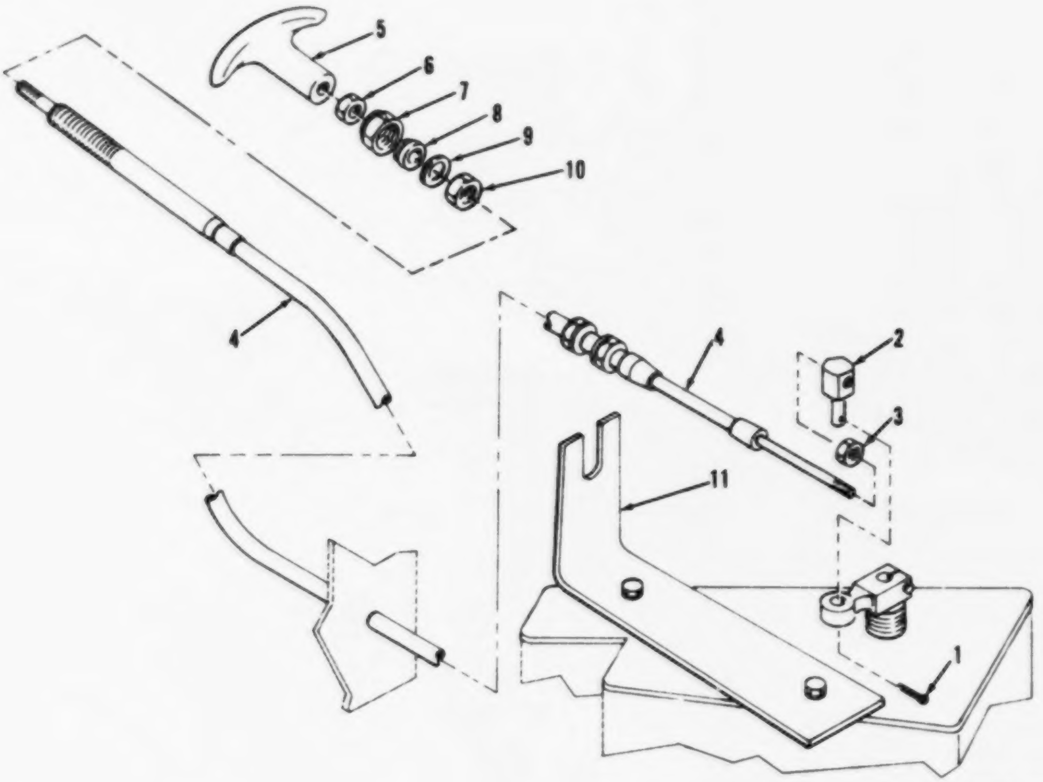
MEC3805-240-35/13-6

1 Nut, plain, hex: 5/16-24
2 Washer, lock: 5/16 in.
3 Ball joint
4 Nut, plain, hex: jam, 5/16-24
5 Rod, thd end
6 Nut, plain, hex: jam, 5/16-24

Figure 13–6. Throttle linkage assembly, exploded view.

7 Nut, plain, hex, 5/16-24
8 Washer, lock, 5/16 in.
9 Ball joint
10 Pin, cotter
11 Pin, clevis
12 Pin, cotter
13 Washer, flat
14 Lever
15 Screw, cap, hex hd: 7/16-14 x 1 1/8 in. (2 rqr)
16 Washer, lock: 7/16 in. (2 rqr)
17 Bracket
18 Clevis, rod end
19 Nut, plain, hex: jam, 5/16-24
20 Rod, thd end
21 Nut, plain, hex: jam, 5/16-24
22 Pin, cotter
23 Pin, clevis
24 Clevis, rod end
25 Pin, cotter
26 Washer, flat
27 Hex pivot
28 Nut, plain, hex: jam, 1/4-28
29 Nut, plain, hex
30 Washer, flat
31 Nut, plain, hex: No. 10-32 (2 rqr)
32 Washer, lock: No. 10 (2 rqr)
33 Screw, mach, p.h.: No. 1-32 x 3/4 in. (2 rqr)
34 Clamp
35 Hand throttle control assembly
36 Handle
37 Packing nut: 5/8-18
38 Sleeve
39 Washer, flat: 5/8 in.
40 Nut, plain, hex: 5/8-18
41 Pin, cotter: 1/8 in. x 1 1/4 in.
42 Washer, flat: 5/8 in.
43 Pedal, foot
44 Nut, plain, hex: 1/2-13 (2 rqr)
45 Washer, lock: 1/2 in. (2 rqr)
46 Screw, cap, hex hd: 1/2-13 x 1 1/4 in. (2 rqr)
47 Bracket, angle
48 Bracket, spring
49 Bracket, helical

Figure 13-6—Continued



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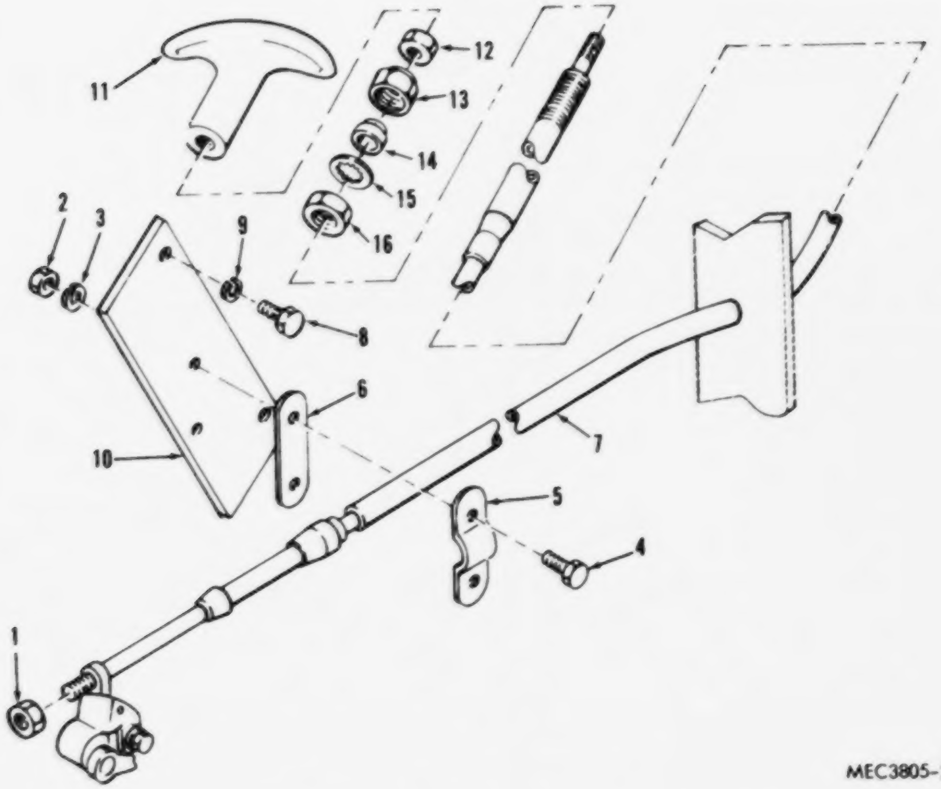
1	Pin, cotter
2	Hex pivot
3	Nut, plain, hex: No. 10-32
4	Cable assembly, push-pull
5	Handle
6	Nut, plain, hex: jam 1/4-20
7	Packing nut
8	Sleeve
9	Washer, flat: 7/16 in.
10	Nut, plain, hex: jam 7/16-20
11	Mounting bracket

Figure 13-7. Engine shut-off control assembly.

(3) Inspect threaded parts for damaged threads and chase with correct size of tap or replace damaged parts as necessary.

d. Reassembly and Installation. Reassemble and install the four-section valve control assembly in reverse of the numerical sequence as illustrated on figure 13-10.

Note. For adjustment instructions, refer to TM 5-3805-240-12.



MEC3805-240-35/13-8

1	Nut, self-locking, 10-32
2	Nut, plain, hex, 10-32
3	Washer, lock, No. 10 (2 rqr)
4	Screw, cap, hex hd, 10-32 x 1/2 in. (2 rqr)
5	Clamp
6	Shim
7	Cable assembly, push-pull
8	Screw, cap, hex hd, 1/4-20 x 5/8 in. (2 rqr)
9	Washer, lock, 1/4 in. (2 rqr)
10	Mounting bracket
11	Handle
12	Nut, plain, hex, 1/4-20
13	Packing nut
14	Sleeve
15	Washer, lock: internal tooth, 7/16 in.
16	Nut, plain, hex: jam, 7/16-20

Figure 13-8. Engine emergency shutdown assembly.

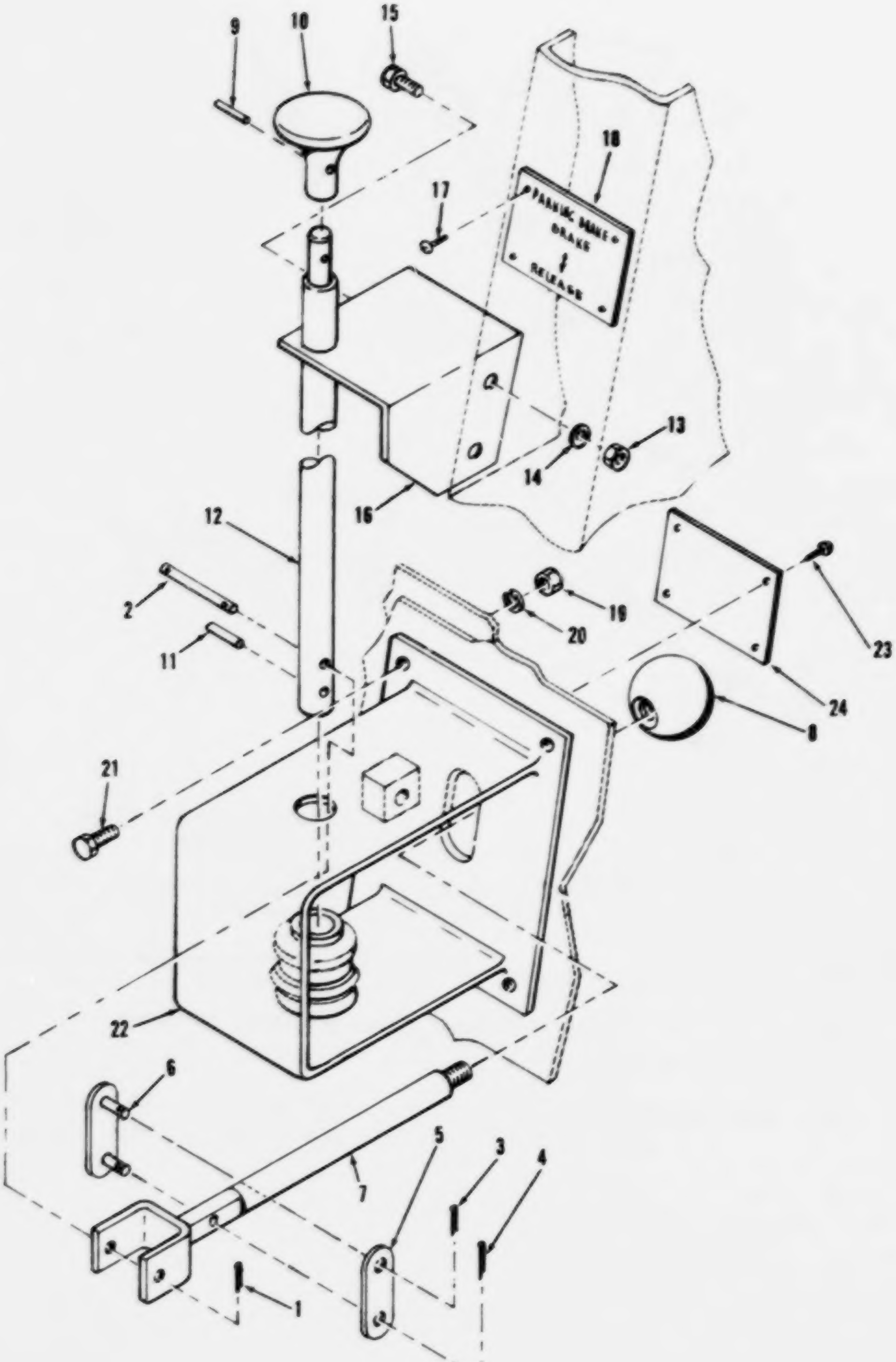

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Figure 13-9. Parking brake control assembly, exploded view.

1 Pin, cotter (2 rqr)
2 Pin, straight
3 Pin, cotter
4 Pin, cotter
5 Link, conn: RH
6 Link, conn: LH
7 Lever
8 Knob
9 Rollpin
10 Knob
11 Rollpin
12 Rod
13 Nut, plain, hex (2 rqr)
14 Washer, lock (2 rqr)
15 Screw, cap, hex hd, 1/4-20 x 1/2 in. (2 rqr)
16 Bracket
17 Screw, drive (4 rqr)
18 Nameplate
19 Nut, plain, hex hd (4 rqr)
20 Washer, lock (4 rqr)
21 Screw, cap, hex hd: 1/4-20 x 5/8 in. (4 rqr)
22 Bracket
23 Screw, drive (4 rqr)
24 Nameplate

Figure 13-9—Continued

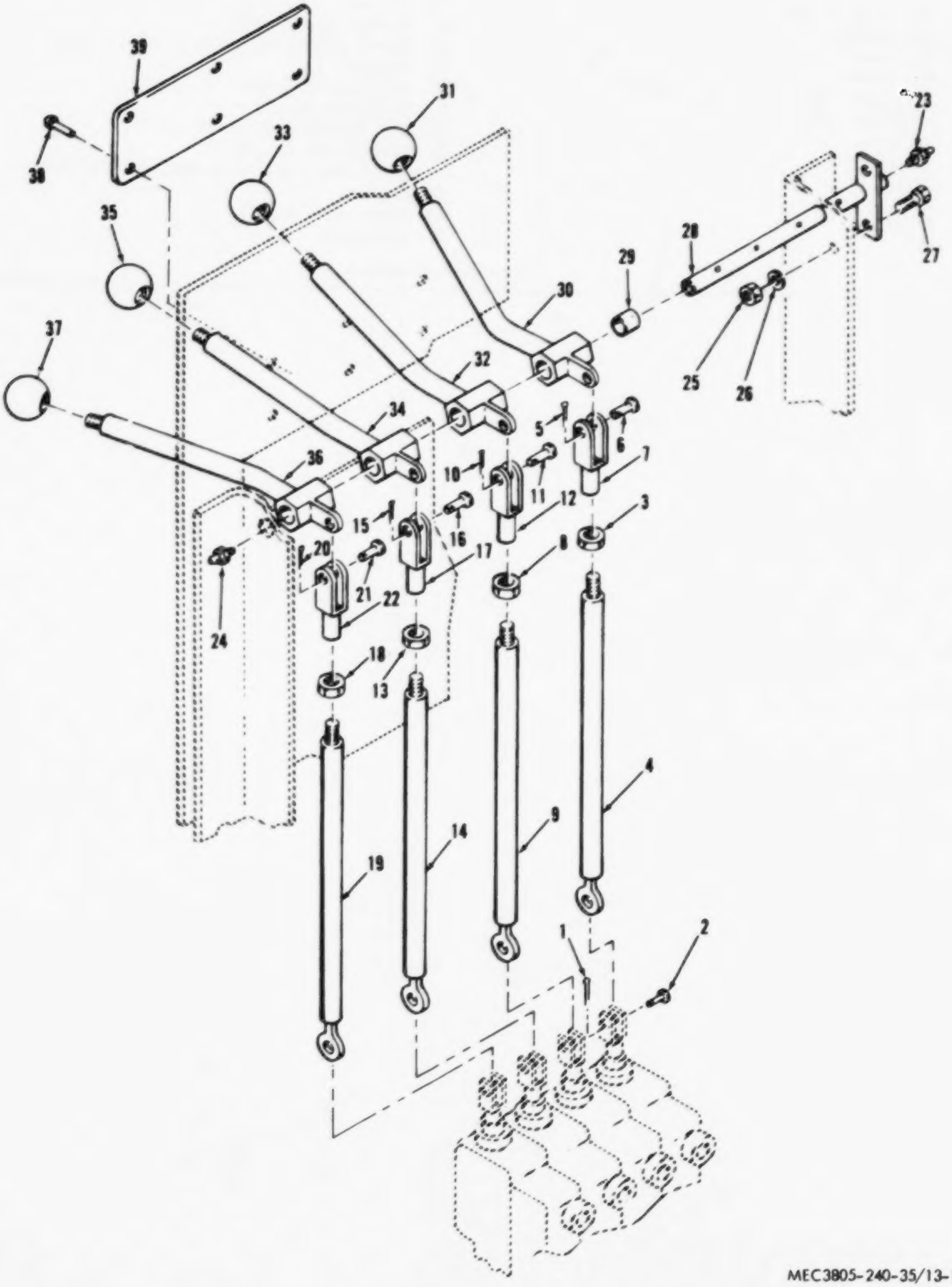
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Figure 13-10. Boom control assembly, exploded view.

1	Pin, cotter (4 rqr)
2	Pin, clevis (4 rqr)
3	Nut, jam, 5/16-24
4	Rod
5	Pin, cotter
6	Pin, clevis
7	Clevis
8	Nut, jam, 5/16-24
9	Rod
10	Pin, cotter
11	Pin, clevis
12	Clevis
13	Nut, jam, 5/16-24
14	Rod
15	Pin, cotter
16	Pin, clevis
17	Clevis
18	Nut, jam, 5/16-24
19	Rod
20	Pin, cotter
21	Pin, clevis
22	Clevis
23	Grease fitting
24	Grease fitting
25	Nut, 1/4-20 (2 rqr)
26	Washer, lock: 1/4 in. (2 rqr)
27	Screw, 1/4-20 x 3/4 in. (2 rqr)
28	Shaft weldment
29	Bearing, sleeve (8 rqr)
30	Lever weldment
31	Knob
32	Lever weldment
33	Knob
34	Lever weldment
35	Knob
36	Lever weldment
37	Knob
38	Screw, drive (6 rqr)
39	Nameplate

Figure 13-10—Continued

Section IV. SEAT ASSEMBLIES

13-12. Driver's Seat Assembly

a. General. The seat assembly consists of cushions, seat belts and a seat frame bolted to an air suspension assembly. The air suspension assembly is bolted to the left on the cab floor. It consists of base assembly, air shock absorber, control valve, vertical adjustment assembly and slide adjuster. Height adjustment is controlled by regulating the adjusting screw. The slide adjuster controls the back and forward adjustment of the seat.

b. Removal and Disassembly. Remove and disassemble the seat and suspension assembly in the numerical sequence as illustrated on figure 13-11.

c. Cleaning, Inspection, and Repair.

(1) Clean all metal parts with an approved solvent or by the live steam-cleaning method.

Caution: **Do not use caustic soda solution for steam cleaning.**

(2) Dry metal parts, using compressed air. Coat steam-cleaned bare metal parts with lubricating oil immediately after drying.

(3) Inspect threaded parts for damaged threads and chase with correct size of tap or replace damaged parts as necessary.

d. Reassembly and Installation. Reassemble and install the seat and suspension assembly in reverse of the numerical sequence as illustrated on figure 13-11.

Note. For adjustment instructions, refer to TM 5-3805-240-12.

13-13. Digging Station Seat Assembly and Pedestal

a. General. The digging station seat assembly consist of a frame, cushions, seat belts, slide adjusters and an upper pedestal. The slide adjusters allow forward and backward adjustment. The seat may be mounted on the lower pedestal that is welded to the cab compartment floor to the right of the driver, or on the pedestal at the digging control station.

b. Removal and Disassembly. Remove and disassemble the digging station seat assembly in the numerical sequence as illustrated on figure 13-12.

c. Cleaning, Inspection, and Repair.

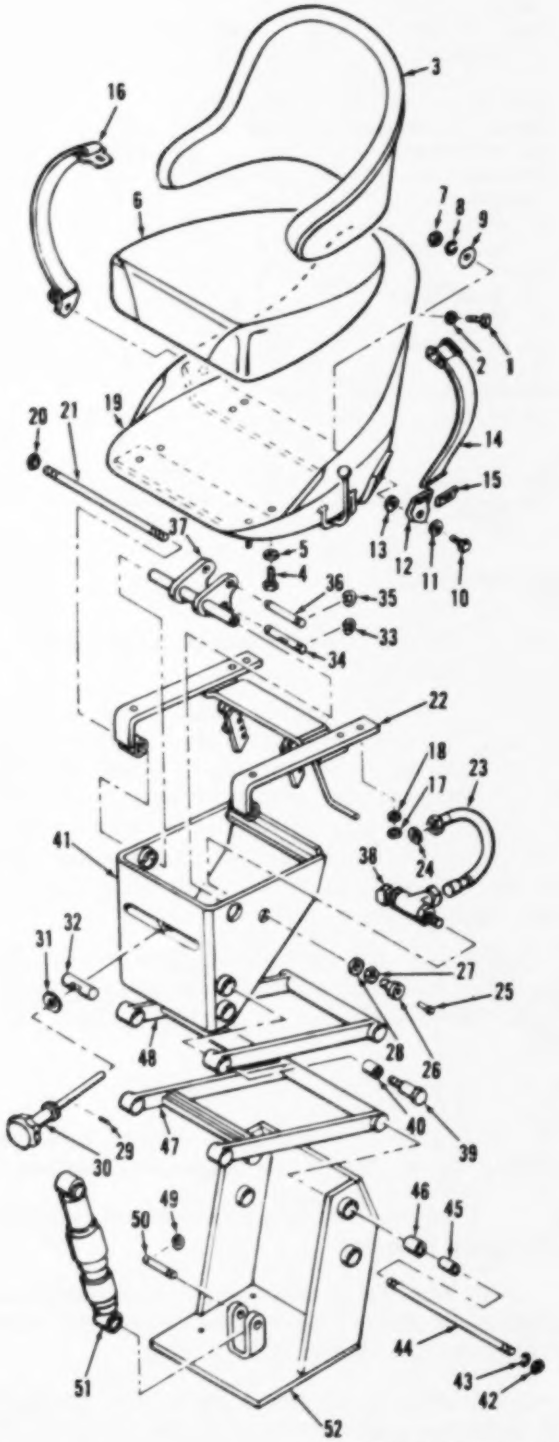
(1) Clean all metal parts with an approved solvent or by the live steam-cleaning method.

Caution: **Do not use caustic soda solution for steam cleaning.**

(2) Dry metal parts, using compressed air. Coat steam-cleaned bare metal parts with lubricating oil immediately after drying.

(3) Inspect threaded parts for damaged threads and chase with correct size of tap or replace damaged parts as necessary.

d. Reassembly and Installation. Reassemble and install the digging station seat assembly in reverse of the numerical sequence as illustrated on figure 13-12.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MEC3805-240-35/13-11

1 Screw, 3/8-16 x 5/8 in. (5 rqr)
2 Washer, flat: 3/8 in. (5 rqr)

Figure 13-11. Driver's seat assembly, exploded view.

3 Seat back
4 Screw, 3/8-16 x 5/8 in. (2 rqr)
5 Washer, flat: 3/8 in. (2 rqr)
6 Cushion, seat
7 Nut (2 rqr)
8 Washer, lock (2 rqr)
9 Washer, convex (2 rqr)
10 Bolt, shoulder (2 rqr)
11 Washer, flat (2 rqr)
12 Mounting plate (2 rqr)
13 Washer, flat (2 rqr)
14 Belt, seat, LH
15 Plate (2 rqr)
16 Belt, seat, RH
17 Nut, 5/16-24 (4 rqr)
18 Washer, lock: 5/16 in. (4 rqr)
19 Shell assembly
20 Nut, plain, hex (2 rqr)
21 Shaft
22 Tilt assembly
23 Hose assembly
24 Gasket
25 Screw, machine
26 Knob
27 Panel nut
28 Washer, lock
29 Roll pin, 7/64 in. x 7/8 in. (2 rqr)
30 Adjusting screw, height
31 Washer, flat, 1/2 in. (2 rqr)
32 Shaft
33 Ring, ret. (2 rqr)
34 Shaft, str.
35 Ring, ret (2 rqr)
36 Shaft
37 Vertical adjustment assembly
38 Valve
39 Bolt, shoulder (4 rqr)
40 Bearing
41 Upper support assembly
42 Nut, jam, 1/2-20 (8 rqr)
43 Washer, lock, 1/2 in. (4 rqr)
44 Shaft
45 Spacer (4 rqr)
46 Bearing, sleeve (4 rqr)
47 Arm
48 Arm
49 Ring, ret (2 rqr)
50 Shaft
51 Shock absorber
52 Base assembly

Figure 13-11—Continued

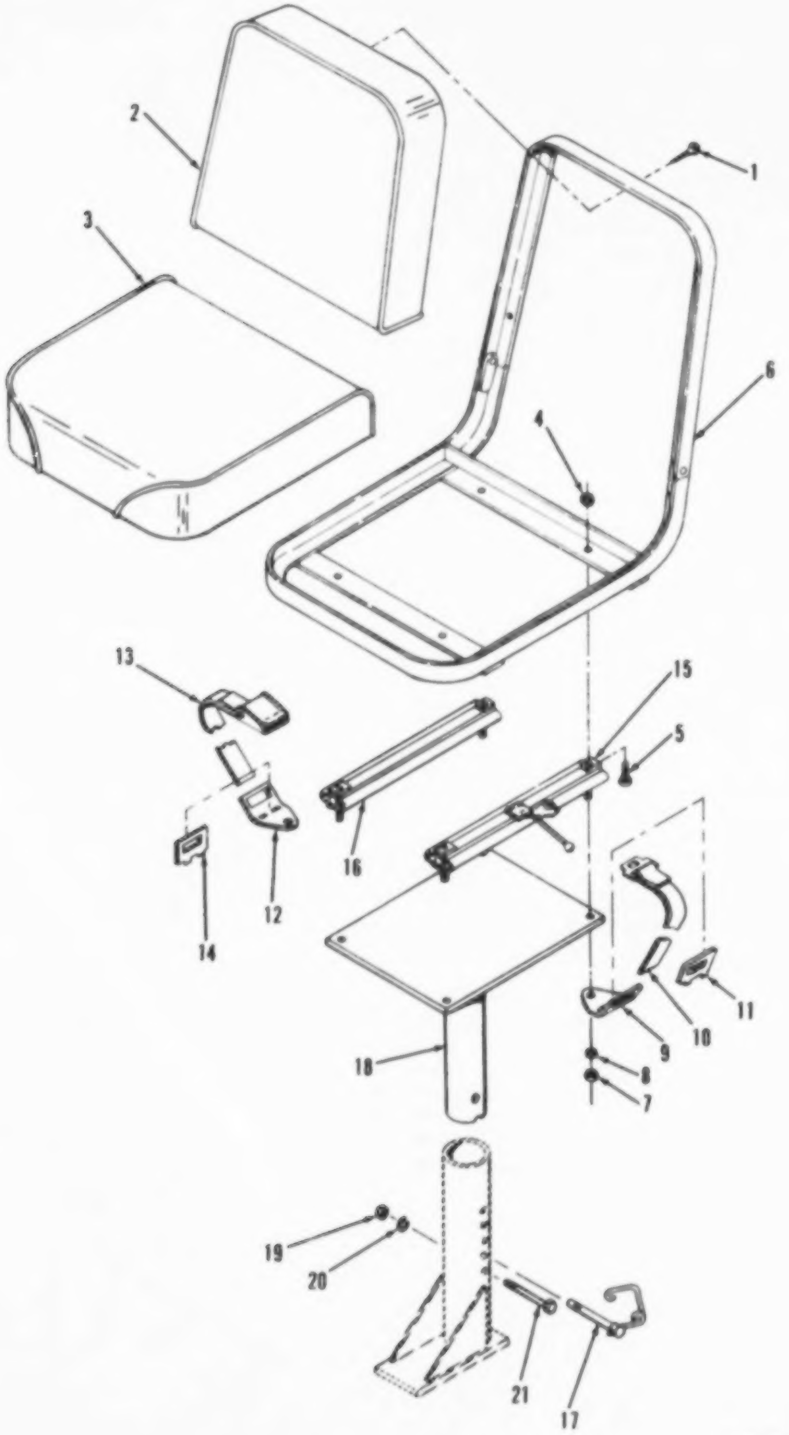
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Figure 13-12. Digging station seat assembly, exploded view.

1 Screw, self tapping (3 rqr)
2 Cushion, back
3 Cushion, seat
4 Nut, 5/16-24 (4 rqr)
5 Screw, 5/16-24 (4 rqr)
6 Frame assembly
7 Nut, 5/16-24 (4 rqr)
8 Washer, lock: 5/16 in. (4 rqr)
9 Mounting plate
10 Belt, seat: RH
11 Plate
12 Mounting Plate
13 Belt, auto safety, lap: LH
14 Plate
15 Seat adjustment, RH
16 Seat adjustment, LH
17 Pin, 3/8 x 2 3/8 in.
18 Upper pedestal
19 Nut, plain, hex
20 Washer, lock
21 Screw, cap, hex hd

Figure 13-12—Continued

Section V. TRANSMISSION CONTROL ASSEMBLY

13-14. General

a. The transmission control assembly is mounted on the cab floor to the right of the driver. The transmission control lever is used to select the various gear ratios provided in the transmission.

b. The neutral start switch prevents the ditcher from being started unless the transmission is in neutral.

c. The downshift inhibitor assembly receives hydraulic fluid under pressure from the lockup port of the transmission/torque converter. This prevents transmission or engine damage by permitting downshifts to be made only when engine speed is sufficiently low.

13-15. Removal and Disassembly

Remove and disassemble the transmission control assembly in the numerical sequence as illustrated on figure 13-13.

13-16. Cleaning, Inspection, and Repair

a. Clean all metal parts with an approved solvent or by the live steam-cleaning method.

Caution: **Do not use caustic soda solution for steam cleaning.**

b. Dry metal parts, using compressed air. Coat steam-cleaned bare metal parts with lubricating oil immediately after drying.

c. Inspect threaded parts for damaged threads and chase with correct size of tap or replace damaged parts as necessary.

13-17. Reassembly and Installation

Reassemble and install the transmission control assembly in reverse of the numerical sequence as illustrated on figure 13-13.

Note. For adjustment instructions, refer to TM 5-3805-240-12.

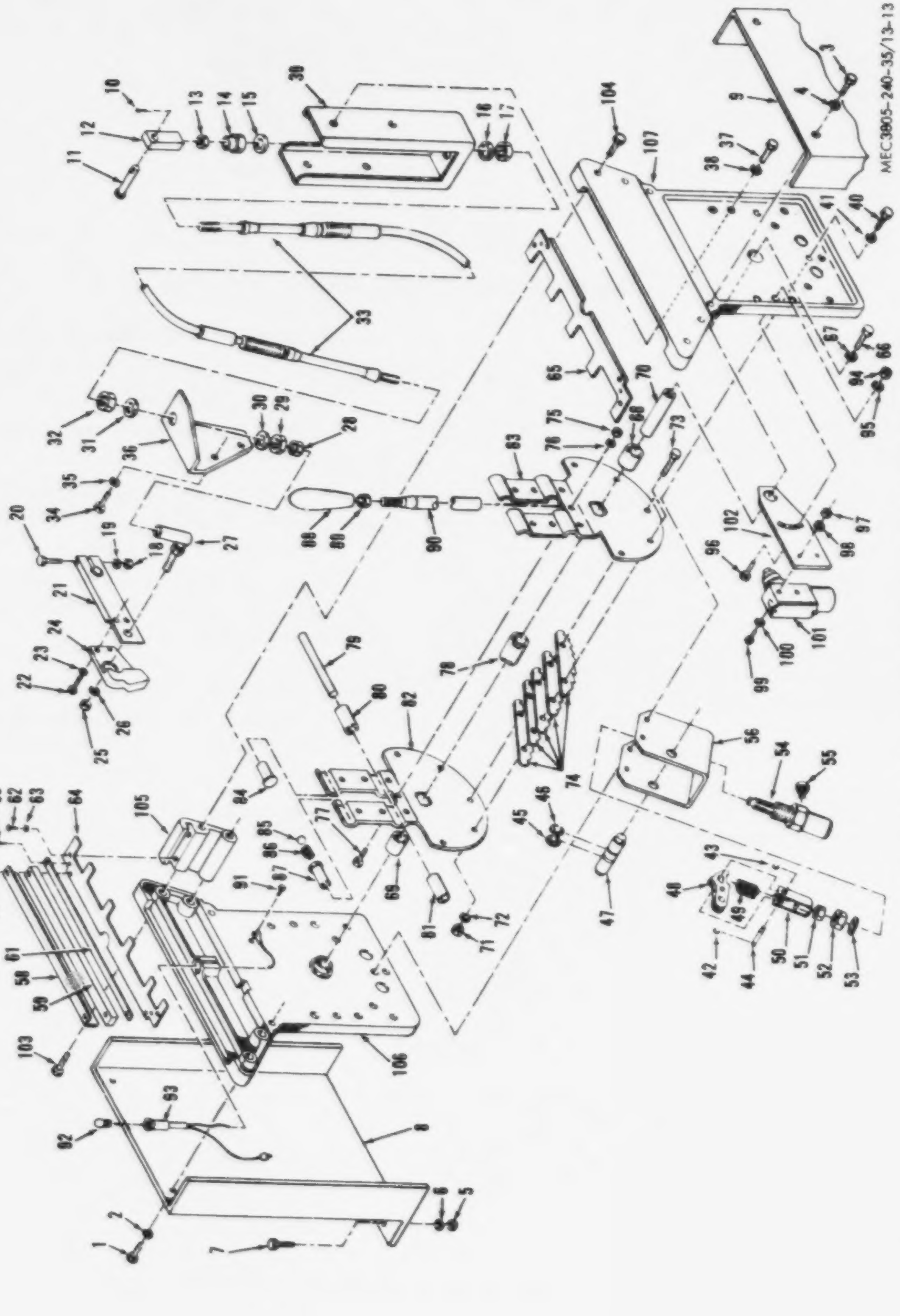
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Figure 13-13. Transmission control assembly, exploded view.

2 Washer, lock: 3/8 in. (2 rqr)
1 Screw, 3/8-16 x 7/8 in. (2 rqr)
3 Screw, 3/8-16 x 7/8 in. (2 rqr)
4 Washer, lock: 3/8 in. (2 rqr)
5 Nut, 3/8-16 (4 rqr)
6 Washer, lock: 3/8 in. (4 rqr)
7 Screw, 3/8-16 x 1 in. (4 rqr)
8 Bracket, RH
9 Bracket, LH
10 Pin, cotter, 3/32 in. x 3/4 in.
11 Pin, clevis
12 Cable connector
13 Nut, jam
14 Nut
15 Washer, flat
16 Washer, flat
17 Nut
18 Nut
19 Washer, lock
20 Screw
21 Lever
22 Screw
23 Washer, lock
24 Cam
25 Nut
26 Washer, lock
27 Ball joint
28 Nut, jam
29 Nut, jam
30 Washer, flat
31 Washer, flat
32 Nut, jam
33 Cable
34 Screw
35 Washer, lock
36 Bracket
37 Screw, 5/16-18 x 3/4 in. (4 rqr)
38 Washer, lock: 5/16 in. (4 rqr)
39 Bracket, control cable
40 Screw, 5/16-18 x 3/4 in. (4 rqr)
41 Washer, lock, 5/16 in. (4 rqr)
42 Ring, retaining
43 Ring, retaining
45 Ring, retaining
46 Ring, retaining
47 Shaft
48 Pawl assembly
49 Spring, pawl
50 Clevis
51 Nut, 5/16-24
52 Nut, 5/8-18
53 Washer, flat, 5/8 in.
54 Cylinder
55 Plug, vent.
56 Bracket, pawl
57 Screw, machine, #10-24 x 1/2 in. (4 rqr)
58 Plate, angle (2 rqr)
59 Spacer bar (2 rqr)
60 Screw, machine, 8-32 x 3/16 in. (4 rqr)
61 Plate (2 rqr)
62 Screw, machine, #10-24 x 1/2 in. (4 rqr)
63 Washer, lock, No. 10 (4 rqr)
64 Plate, gate, LH
65 Plate, gate, RH
66 Screw
67 Washer, lock
68 Bearing, sleeve
69 Bearing, sleeve
70 Shaft
71 Nut, 5/16-18(2 rqr)
72 Washer, lock, 5/16 in. (2 rqr)
73 Screw, 5/16-18 x 1 1/4 in. (2 rqr)
74 Ratchet segment (5 rqr)
75 Nut, 1/4-28 (7 rqr)
76 Washer, lock, 1/4 in. (7 rqr)
77 Screw, 1/4-28 x 5/8 in. (7 rqr)
78 Spacer
79 Shaft
80 Journal
81 Journal
82 Shift plate
83 Shift plate
84 Strike, ball detent
85 Ball
86 Spring, ball
87 Tube, ball detent
88 Knob
89 Nut, jam, 1/2-13
90 Handle
91 Screw, self tapping, No. 8-32 x 5/16 in. (2 rqr)
92 Bulb, 24V (2 rqr)
93 Socket assembly (2 rqr)
94 Nut
95 Washer, lock
96 Screw
97 Nut, No. 6-32(2 rqr)
98 Washer, lock, No. 6
99 Screw, machine, No. 6-32 x 1 1/2 in. (2 rqr)
100 Washer, lock, No. 6
101 Switch, neutral start
102 Plate, switch mounting
103 Screw, 3/8-16 x 7/8 in. (4 rqr)
104 Screw, 3/8-16 x 7/8 in. (4 rqr)
105 Spacer, housing (2 rqr)
106 Housing, LH
107 Housing, RH

Figure 13-13—Continued

Section VI. WINDSHIELD WIPER ASSEMBLY

13–18. General

The windshield wipers are mounted at the top of the windshield. Pantograph arms are mounted on the gear shafts. Wiper blades are fastened to the arms. The wiper operating switch is mounted on the instrument panel to the right of the driver.

13–19. Removal and Disassembly

Remove and disassemble the windshield wiper assembly in the numerical sequence as illustrated on figure 13–14.

13–20. Cleaning, Inspection, and Repair

a. Clean all metal parts with an approved solvent or by the live steam-cleaning method.

Caution: **Do not use caustic soda solution for steam cleaning.**

b. Dry metal parts, using compressed air. Coat steam-cleaned bare metal parts with lubricating oil immediately after drying.

c. Inspect threaded parts for damaged threads and chase with correct size of tap or replace damaged parts as necessary.

13–21. Reassembly and Installation

Reassemble and install the windshield wiper assemblies in reverse of the numerical sequence as illustrated on figure 13–14.

Note. For adjustment instructions, refer to TM 5-3805-240-12.

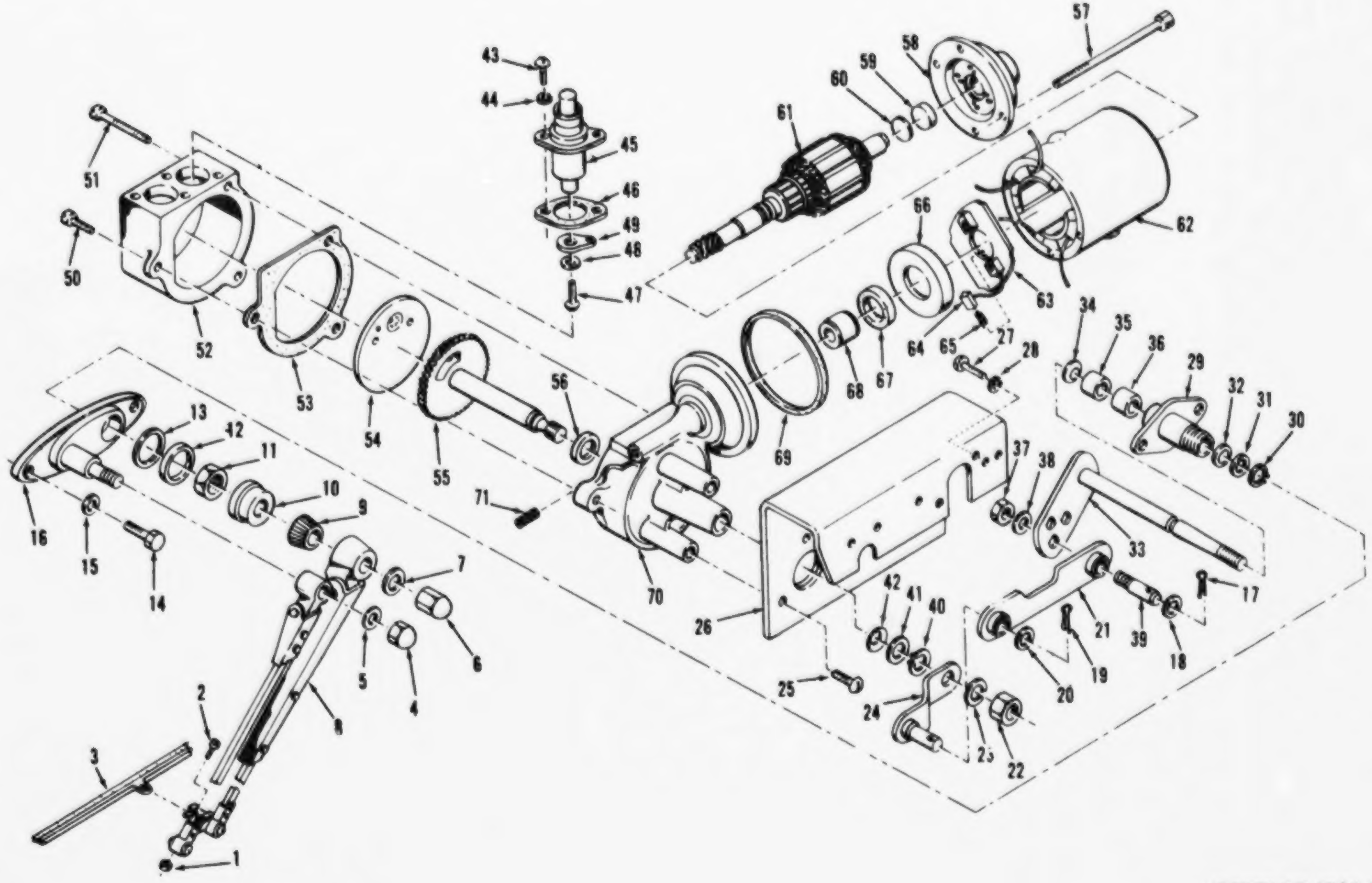
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Figure 13-14. Windshield wiper assembly, exploded view.

1	Stop nut
2	Screw, machine
3	Wiper blades
4	Nut, acorn
5	Washer, flat
6	Nut, acorn
7	Washer, flat
8	Wiper arm assembly
9	Nut, knurled
10	Cap
11	Nut
12	Washer, flat
13	Washer, flat
14	Screw (2 rqr)
15	Washer, flat (2 rqr)
16	Mounting plate, pivot
17	Pin, cotter
18	Washer, flat
19	Pin, cotter
20	Washer, flat
21	Link, connecting
22	Nut
23	Washer, lock
24	Arm assembly, drive
25	Screw, machine (3 rqr)
26	Bracket
27	Screw, machine (2 rqr)
28	Washer, flat (2 rqr)
29	Spacer, liner
30	Ring, retaining
31	Washer, flat
32	Washer, bowed
33	Shaft and lever assembly
34	Washer, bowed
35	Bearing, sleeve
36	Bearing, sleeve
37	Nut
38	Washer, lock
39	Pin
40	Ring, retaining
41	Washer, flat
42	Washer, spring
43	Screw, machine (4 rqr)
44	Washer, lock (4 rqr)
45	Capacitor (2 rqr)
46	Gasket (2 rqr)
47	Screw, machine (2 rqr)
48	Washer (2 rqr)
49	Terminal clip (2 rqr)
50	Screw, machine
51	Screw, machine
52	Cover
53	Gasket
54	Plate, insulation
55	Gear
56	Washer, flat
57	Screw (2 rqr)
58	Cap assembly
59	Disc, thrust
60	Disc, thrust
61	Armature assembly
62	Housing assembly, motor
63	Brush holder assembly
64	Brush (2 rqr)
65	Spring
66	Cup, retaining
67	Packing, preformed
68	Bearing sleeve
69	Packing, preformed
70	Housing assembly
71	Set screw

Figure 13-14—Continued

Section VII. CANVAS AND FRAME ASSEMBLY

13-22. General

The operator's cab has canvas top, back and side panels supported by a tubular steel frame and three wooden roof slats. The canvas panels can be used together or individually as the operator desires. Clear, plastic windows are stitched into the back and side panels. Snap fasteners are used to attach panels to the cab frame. When not in use, the canvas panels and frame members are stored behind the driver's seat in the cab. A canvas windshield cover is also provided. Store the windshield cover in the tool box when not in use.

13-23. Removal

Refer to TM 5-3805-240-12 and remove the canvas and frame assembly.

13-24. Inspection and Repair

a. Refer to TM 10-269 and inspect and repair canvas components.

b. Inspect tubular steel frame members and cab parts for damaged fastener posts, hinges, and sockets. Repair or replace damaged or worn parts. Repaint as required.

c. Inspect wooden roof slats for wear, splitting, or other damage. Repair, re-paint, or replace defective slats.

13-25. Installation

Refer to TM 5-3805-240-12 and install the canvas and frame assembly.

CHAPTER 14

DIGGING MECHANISM REPAIR INSTRUCTIONS

Section I. SPOIL CONVEYOR ASSEMBLY

14–1. General

The conveyor assembly consists of a welded steel frame, a rubber belt on drums driven by two reversible hydraulic motors, and four idler roller shafts. A third hydraulic motor moves the conveyor to the right or left to discharge spoil on either side of the ditch.

14–2. Removal

Refer to paragraph 2–50 and remove the conveyor assembly.

14–3. Disassembly

a. Disassemble the conveyor in the numerical sequence as shown on figure 14–1.

b. Refer to TM 5-3805-240-12 for hydraulic hose and fitting repair instructions.

14–4. Cleaning

a. Wash all metal parts in approved solvent and dry with compressed air.

b. Clean conveyor belt, idler rollers, flashing strips and hydraulic hose assemblies with an approved cleaning solvent for rubber and dry thoroughly with compressed air.

c. Remove paint which is flaking or has deteriorated.

14–5. Inspection and Repair

a. Inspect the frame weldment (80, fig. 14–1) for cracked welds, broken parts, or a bent frame. Repair broken welds by re-welding. Replace a bent or badly damaged frame. Repaint as required.

b. Inspect idler roller shafts (74) for bending or other damage. Replace shafts which cannot be satisfactorily straightened.

c. Check all bearings (39, 48, 59, 72) for excessive wear or damage. Replace bearings as required.

d. Inspect the conveyor belt (11) for excessive wear, cuts or abrasions, particularly near the lacing (12). Replace a badly worn or damaged belt and lacing. If the belt is not too badly worn, trim ends just behind the lacing bolt holes and install a new lacing set. Adjust the drum shafts as required for the shortened belt.

e. Inspect all threaded parts for rusty, worn or damaged threads. Replace defective parts.

f. Inspect rubber impact rollers (76) and flashing strips (8, 9) for wear, abrasions, cuts or other damage. Replace rollers or flashing strips as required.

14–6. Reassembly

Reassemble the conveyor in reverse of the numerical sequence as illustrated on figure 14–1.

14–7. Installation

Refer to paragraph 2–50 and install the conveyor assembly.

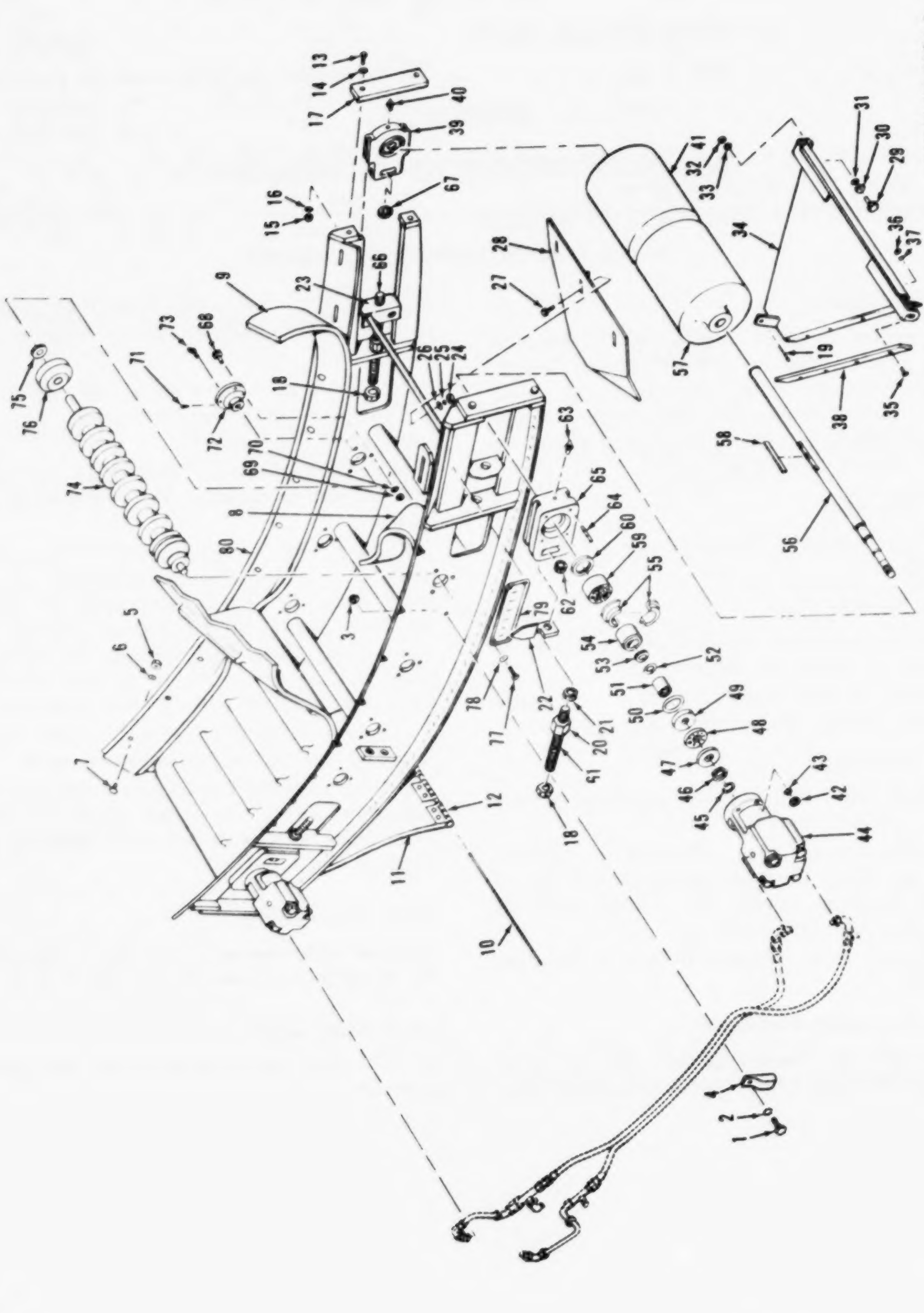
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Figure 14-1. Spoil conveyor assembly, exploded view.

1 Screw, cap, 3/8-16 x 3/4 in.
2 Washer, lock, 3/8 in.
3 Nut, hex, 3/8-16
4 Clamp, hose
5 Nut, hex, 5/16-18 (24 rqr)
6 Washer, lock, 5/16 in. (24 rqr)
7 Bolt, elevator, No. 2 hd 5/16-18 x 1 in. (24 rqr)
8 Flashing
9 Flashing
10 Pin, belt fastener
11 Belt
12 Lacing set
13 Screw, cap, 1/2-13 x 1 1/2 in. (8 rqr)
14 Washer, flat, 1/2 in. (8 rqr)
15 Nut, hex, 1/2-13 (8 rqr)
16 Washer, lock, 1/2 in. (8 rqr)
17 End plate (4 rqr)
18 Nut, jam, heavy, 1-8 (4 rqr)
19 Pin, cotter 1/4 x 2 in. (2 rqr)
20 Nut, hex, 1-8 (4 rqr)
21 Nut, jam, heavy, 1-8 (4 rqr)
22 Indicator assembly (4 rqr)
23 Mounting bracket (2 rqr)
24 Nut, hex, 3/8-16 (6 rqr)
25 Washer, lock, 3/8 in. (6 rqr)
26 Washer, flat, 3/8 in. (6 rqr)
27 Bolt, carriage, 3/8-16 x 1 in. (6 rqr)
28 Scraper, drum
29 Screw, cap, 3/8-16 x 1 1/2 in. (4 rqr)
30 Nut, jam, 3/8-16 (4 rqr)
31 Washer, flat, 3/8 in. (4 rqr)
32 Nut, jam, 3/8-16 (4 rqr)
33 Washer, flat, 3/8 in. (4 rqr)
34 Scraper, belt (2 rqr)
35 Bolt, elevator, No. 2 hd. 5/16-18 x 1 1/4 in. (16 rqr)
36 Nut, hex, 5/16-18 (16 rqr)
37 Washer, lock, 5/16 in (16 rqr)
38 Flashing (4 rqr)
39 Bearing, take-up (2 rqr)
40 Grease fitting (2 rqr)
41 Drum (2 rqr)
42 Nut, hex, 3/8-16 (8 rqr)
43 Washer, lock, 3/8 in. (8 rqr)
44 Motor, conveyor drive (2 rqr)
45 Ring, retaining (2 rqr)
46 Retainer (2 rqr)
47 Race, thrust bearing (2 rqr)
48 Cage, thrust bearing (2 rqr)
49 Race, thrust bearing (2 rqr)
50 Packing, preformed (2 rqr)
51 Bearing, needle (2 rqr)
52 Packing, preformed (2 rqr)
53 Ring, back-up (2 rqr)
54 Sleeve, bearing (2 rqr)
55 Spacer, split (2 rqr)
56 Shaft, drum (2 rqr)
57 Drum (2 rqr)
58 Key, square, 7/16 x 7/16 x 4 1/2 in.
59 Bearing, ball (2 rqr)
60 Seal, oil (2 rqr)
61 Rod, threaded, 1-8 x 9 in. (2 rqr)
62 Nut, jam, heavy, 1-8 (2 rqr)
63 Grease fitting (2 rqr)
64 Stud, threaded, 3/8-16 x 2 in. (8 rqr)
65 Flange, mounting (2 rqr)
66 Rod, threaded, 1-8 x 9 in. (2 rqr)
67 Nut, jam, heavy 1-8 (2 rqr)
68 Bolt, carriage, 3/8-16 x 1 in. (24 rqr)
69 Nut, hex, 3/8-16 (24 rqr)
70 Washer, lock, 3/8 in. (24 rqr)
71 Screw, set (8 rqr)
72 Bearing, roller (8 rqr)
73 Grease fitting (8 rqr)
74 Shaft, impact roller (4 rqr)
75 Washer, special (8 rqr)
76 Roller, impact, rubber (40 rqr)
77 Screw, machine, rd. hd., 10-32 x 7/16 in. (16 rqr)
78 Washer, lock, 7/16 in. (16 rqr)
79 Gage, visual (4 rqr)
80 Frame

Figure 14-1—Continued

Section II. BUCKET LINE ASSEMBLY

14-8. General

The bucket line assembly consists of eighteen buckets connected by rollered links which run around the head and foot shaft sprockets. Each bucket has a built-in wiper plate which ejects material onto the spoil conveyor.

14-9. Removal

Refer to paragraph 2-52 and remove the bucket line assembly.

14-10. Dissasembly

Disassemble the bucket line in the numerical sequence as illustrated on figure 14-2.

14-11. Cleaning

a. Remove dirt or caked mud from all parts.

b. Wash all parts in approved solvent and dry with compressed air.

14-12. Inspection and Repair

a. Inspect the buckets (11, fig. 14-2) for excessive wear on the sides. Replace badly worn buckets.

b. Inspect buckets and wiper plates (7) for cracks, broken welds or bending. Repair by welding and grind welds smooth.

c. Inspect pivot holes and ears on wiper plates for damage or excessive wear. Replace defective wiper plates.

d. Inspect side links (9) for damage and wear. Replace badly worn or damaged links.

e. Inspect all pins, bearing sleeves and rollers for excessive wear or damage (5, 6, 8, 10). Replace defective parts.

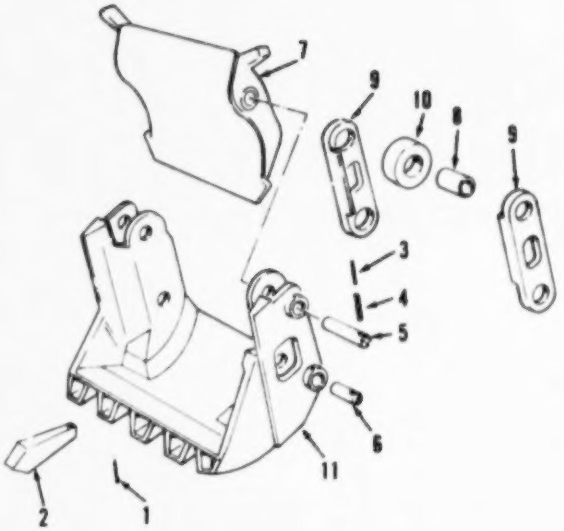
f. Refer to TM 5-3805-240-12 and replace bucket teeth as required.

14-13. Reassembly

Reassemble the bucket line in reverse of the numerical sequence as illustrated on figure 14-2.

14-14. Installation

Refer to paragraph 2-52 and install the bucket line assembly.



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1 Cotter pin (90 rqr)
2 Tooth (90 rqr)
3 Roll pin (72 rqr)
4 Roll pin (72 rqr)
5 Pin, long (36 rqr)
6 Pin, short (36 rqr)
7 Wiper plate, RH, (9 rqr) and LH (9 rqr)
8 Bushing (72 rqr)
9 Link (36 rqr)
10 Roller (72 rqr)
11 Bucket, R.H. (9 rqr) and LH (9 rqr)

Figure 14-2. Bucket, exploded view.

Section III. BOOM ASSEMBLY

14-15. General

a. The boom assembly consists of the boom frame, bucket line, sprockets, shafts, and spreader arms. The boom frame has an adjustable foot to maintain the proper tension on the bucket line.

b. The boom frame also supports the spoil conveyor and follow-up scraper which are described above and in TM 5-3805-240-12.

c. If an obstruction stops the bucket line, the bucket line drive clutch on the transfer case will slip to prevent damaging the bucket line or boom assembly.

14-16. Removal

a. Refer to TM 5-3805-240-12 and remove the follow-up scraper and boom cover.

b. Refer to paragraph 2-50 and remove the spoil conveyor.

c. Refer to paragraph 2-52 and remove the bucket line.

d. Refer to figure 14-3 and remove the boom foot assembly (2).

e. Operate the diesel engine and lower the boom hoist assembly until the boom frame assembly (84) rests on the floor.

f. Attach a sling and suitable lifting device to the head shaft (54) on the boom frame. Remove enough slack from sling to support the boom frame assembly.

g. Refer to TM 5-3805-240-12 and remove the hoist cable.

h. Refer to TM 5-3805-240-12 and remove the two bucket line drive chains.

i. Remove the spreader arms (25, 26, fig. 14-3) from the sprocket drive assembly (68, fig. 14-4).

Note. Match mark bearing caps (6, fig. 14-3) before removing.

j. Refer to figure 14-3 and remove the two guide rollers (12) from the boom frame assembly.

k. Use the lifting device to separate the boom frame assembly from the boom guide assembly and lay it down on the floor.

14-17. Disassembly

Disassemble the boom assembly in the numerical sequence as illustrated on figure 14-3.

Note. Match mark bucket line sprocket halves before disassembly.

14-18. Cleaning

Wash all parts in approved solvent and dry with compressed air.

14-19. Inspection and Repair

a. Head Shaft and Sprockets.

(1) Inspect the shaft (53, fig. 14-3) for scoring, cracking or bending. Slight scoring can be smoothed with fine crocus cloth wet with fuel oil. Replace a cracked, bent, or badly worn shaft.

(2) Inspect the sprockets (17) for bends and badly worn teeth. Replace defective sprockets.

Note. The four-toothed bucket drive sprockets (59) are composed of matched pairs. Always match marks before installing repaired or new sprockets.

(3) Inspect all threaded parts for stripped, worn or defective threads. Repair or replace defective parts.

(4) Replace oil seals (23, 51).

(5) Inspect roller bearings (46) for wear or binding. Replace defective bearings.

(6) Inspect keys (18, 55) for deformation or burrs. Repair or replace defective keys.

b. Foot Shaft and Sprocket.

(1) Inspect the shaft (72) for scoring, bending or excessive wear. Be sure grease ports are unclogged. A slightly damaged shaft can be repaired by careful grinding or smoothing with crocus cloth. Replace a badly worn or damaged shaft.

(2) Inspect the sprocket assembly (73) for badly worn teeth, broken welds and worn bearings. Replace defective parts.

(3) Replace oil seals (75, 78).

Note. Dip leather surface in oil just before installing oil seal.

(4) Inspect the washers (74, 77) for excessive wear, scoring or other damage. Replace defective washers.

(5) Inspect plugs (80, 82) and grease fitting (81, 83) for rust and damaged threads. Replace defective parts.

c. Spreader Arms.

(1) Inspect all threaded parts for stripped, worn or damaged parts. Repair or replace defective parts.

(2) Inspect spreader arm weldments (25, 26) for bends, dents, or broken welds. Repair or replace badly damaged arms.

(3) Inspect sprockets (35) and sprocket brackets (32) for scoring, excessive wear, damaged sprockets or weldments. Repair or replace defective parts.

(4) Examine bearings (41) for excessive wear, scoring or chipping. Replace defective bushing.

(5) Inspect bearing caps (6) for scoring, excessive wear or other damage. Be sure the lubrication ports and grooves are clean and undamaged. Light scoring can be smoothed out with fine crocus cloth wet with fuel oil. Replace badly worn or damaged parts.

***Caution:* Observe match marks when reassembly bearing caps for proper alignment.**

d. Digging Boom Frame.

(1) Inspect all parts for cracked or broken welds. Re-weld as required.

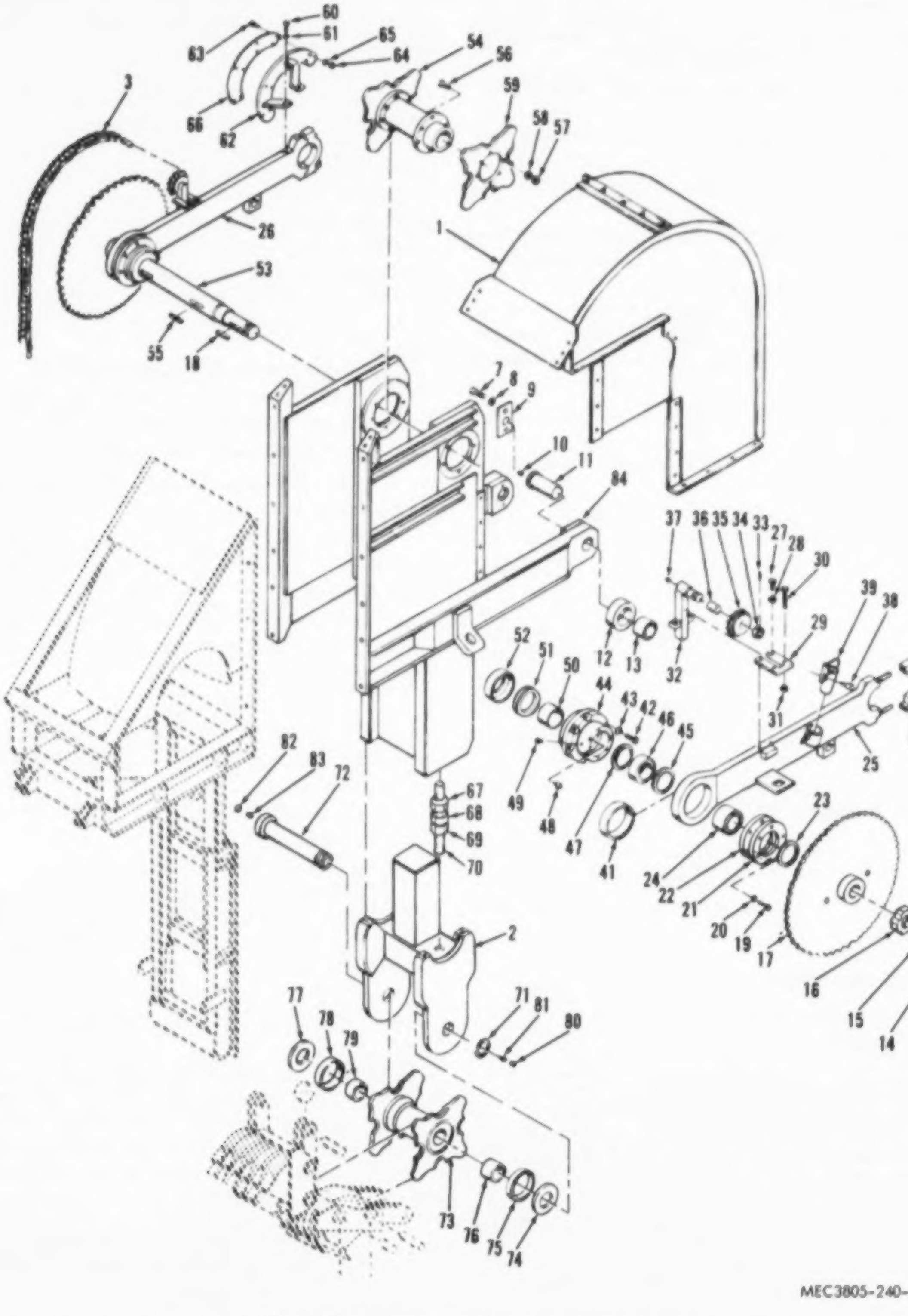
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Figure 14-3. Digging boom assembly, exploded view.

1 Boom cover assembly
2 Boom foot
3 Drive chain (rqr)
4 Jam nut, 1-8 (4 rqr)
5 Hex nut, 1-8 (4 rqr)
6 Bearing cap (2)
7 Bolt, 1/2-13 x 1 1/4 in. (4 rqr)
8 Lockwasher, 1/2 in. (4 rqr)
9 Retaining bar (2 rqr)
10 Grease fitting (2 rqr)
11 Pin (2 rqr)
12 Roller (2 rqr)
13 Bearing, bronze (2 rqr)
14 Lock nut (2 rqr)
15 Lockwasher (2 rqr)
16 Locknut (2 rqr)
17 Sprocket (2 rqr)
18 Key (2 rqr)
19 Bolt, 7/16-14 x 1 1/4 in. (12 rqr)
20 Lockwasher, 7/16 (12 rqr)
21 Bearing cover (2 rqr)
22 Shim (AR)
23 Oil seal (2 rqr)
24 Spacer (2 rqr)
25 Spreader arm, R.H.
26 Spreader arm, L.H.
27 Bolt, 3/4-10 x 1 1/4 in. (4 rqr)
28 Lockwasher, 3/4 in. (4 rqr)
29 Plate (2 rqr)
30 Bolt, 3/4-10 x 6 in. (4 rqr)
31 Jam nut 3/4-10 (4 rqr)
33 Set screw, 3/8-16 x 3/8 in. (2 rqr)
34 Collar (2 rqr)
35 Sprocket (2 rqr)
36 Bearing, bronze (2 rqr)
37 Grease fitting (2 rqr)
38 Boom lock pin (2 rqr)
39 Boom lock (2 rqr)
40 Grease fitting (2 rqr)
41 Bearing, bronze (2 rqr)
42 Bolt, 3/4-10 x 2 in. (2 rqr)
43 Lockwasher, 3/4 in. (12 rqr)
44 Bearing Housing (2 rqr)
45 Retaining ring
46 Bearing, roller (2 rqr)
47 Retaining ring
48 Grease fitting (4 rqr)
49 Plug (2 rqr)
50 Spacer (2 rqr)
51 Oil seal (2 rqr)
52 Seal retainer (2 rqr)
53 Head shaft
54 Head shaft sleeve
55 Key (2 rqr)
56 Bolt, 3/4-10 x 3 in. (16 rqr)
57 Nut, 3/4-10 (16 rqr)
58 Lockwasher, 3/4 in. (16 rqr)
59 Sprocket (2 rqr)
60 Bolt, 1/2-13 x 3/4 in. (2 rqr)
61 Lockwasher, 3/4 in. (2 rqr)
62 Depth indicator bracket
63 Screw, 10-32 x 3/8 in. (8 rqr)
64 Nut, 10-32 (8 rqr)
65 Lockwasher, No. 10 (8 rqr)
66 Depth indicator plate
67 Nut, special LH th'd. (2 rqr)
68 Lock nut, special (2 rqr)
69 Nut, special (2 rqr)
70 Stud (2 rqr)
71 Retaining ring
72 Foot shaft
73 Foot sprocket
74 Washer
75 Oil seal
76 Bearing, bronze
77 Washer
78 Oil seal
79 Bearing, bronze
80 Pipe plug
81 Grease fitting
82 Pipe plug
83 Grease fitting
84 Digging boom

Figure 14-3—Continued

(2) Inspect all threaded parts for rust and worn or damaged threads. Replace defective parts.

(3) Repaint as required.

e. Boom Foot.

(1) Inspect boom foot weldment (2) for bends, cracked or broken welds, and excessive wear. Repair or replace as required.

(2) Inspect adjusting screws (70) and nuts (67, 68, 69) for rust, worn or damaged theads. Repair or replace defective parts.

(3) Repaint as required.

14-20. Reassembly

Reassemble the boom assembly in reverse of the numerical sequence as illustrated on figure 14-3.

14-21. Installation

Install the boom assembly by reversing the procedures for removal in paragraph 14-16.

Section IV. BOOM GUIDE AND HOIST ASSEMBLY

14-22. General

a. The main components of the boom guide and hoist assembly are the guide weldment, the bucket line right-angle drive assembly and the boom hoist assembly.

b. The boom guide assembly fastens to a pivoting shaft at the rear of the ditcher. Two hydraulic cylinders move the boom guide back and forth from the digging to transport positions. The boom guide supports the digging boom, spoil conveyor, and follow-up scraper assemblies.

c. The boom hoist assembly is mounted to the boom guide. When locked in the digging position, the boom guide assembly transfers all forces from the digging boom to the ditcher frame.

14-23. Removal

a. Refer to paragraph 14-16 and remove the boom assembly.

b. Attach a sling to the lifting eyes in the boom guide and use a suitable lifting device to support the boom guide assembly.

c. Refer to paragraph 2-56 and disconnect the drive shaft from the sprocket drive assembly (68, fig. 14-4).

d. Refer to figure 14-4 and remove items 6 through 40.

e. Slowly lift the boom guide and hoist assembly away from the ditcher frame being careful not to damage the hydraulic cylinders and lines.

f. For safety, lay the boom guide and hoist assembly on the floor before further disassembly.

14-24. Disassembly

a. Disassemble the boom guide and hoist assembly in the numerical sequence as illustrated on figure 14-4.

b. Refer to paragraph 6-18 for right-angle drive assembly repair instructions.

c. Refer to paragraph 8-7 for hydraulic cylinder repair instructions.

d. Refer to paragraph 10-4 for drive shaft repair instructions.

14-25. Cleaning

a. Remove any mud, dirt, rust or loose paint.

b. Wash all parts in approved solvent and dry with compressed air.

14-26. Inspection and Repair

a. Inspect boom guide weldment (41, fig. 14-4) for cracked or broken welds, bent or damaged component parts. Repair by welding and straightening where practical. Replace a badly damaged boom guide weldment.

b. Inspect the shafts (10, 40) for scoring, distortion or excessive wear. Slight scoring can be smoothed out with fine crocus cloth wet with fuel oil. Thoroughly clean the shaft before reassembly. Replace a badly damaged or worn shaft.

c. Inspect the drive sprockets (43, 56) for worn or broken teeth. Replace defective sprockets.

d. Inspect the bushings (51, 64) and flange bearing (52, 65) for wear, chipping or pitting. Replace defective bushings or bearings.

e. Inspect the sprocket drive tilt links (78) for cracked or broken welds, bends, and worn mounting holes. Repair by welding and grind welds smooth. Repaint as required. Replace badly worn or damaged tilt links.

f. Inspect all threaded parts for rusty, worn or damaged threads. Replace defective parts.

g. Inspect all mounting and pivot pins and cotter pins for damage, wear, or distortion. Replace defective pins.

h. Inspect the hoist mast frame (28) for damaged welds, bent sheave cover plates and misalined frame members. Repair by welding, straightening, and repainting. Replace a badly damaged mast frame.

i. Inspect the bronze bushings (12, 23, 30) for wear, scoring or pitting. Replace defective bushings.

j. Inspect the sheaves (10, 21) for wear or damage. Replace defective parts.

14-27. Reassembly

Reassemble the boom guide and hoist assembly in reverse of the numerical sequence as illustrated on figure 14-4.

14-28. Installation

Install the boom guide and hoist assembly by reversing the procedures for removal in paragraph 14-23.

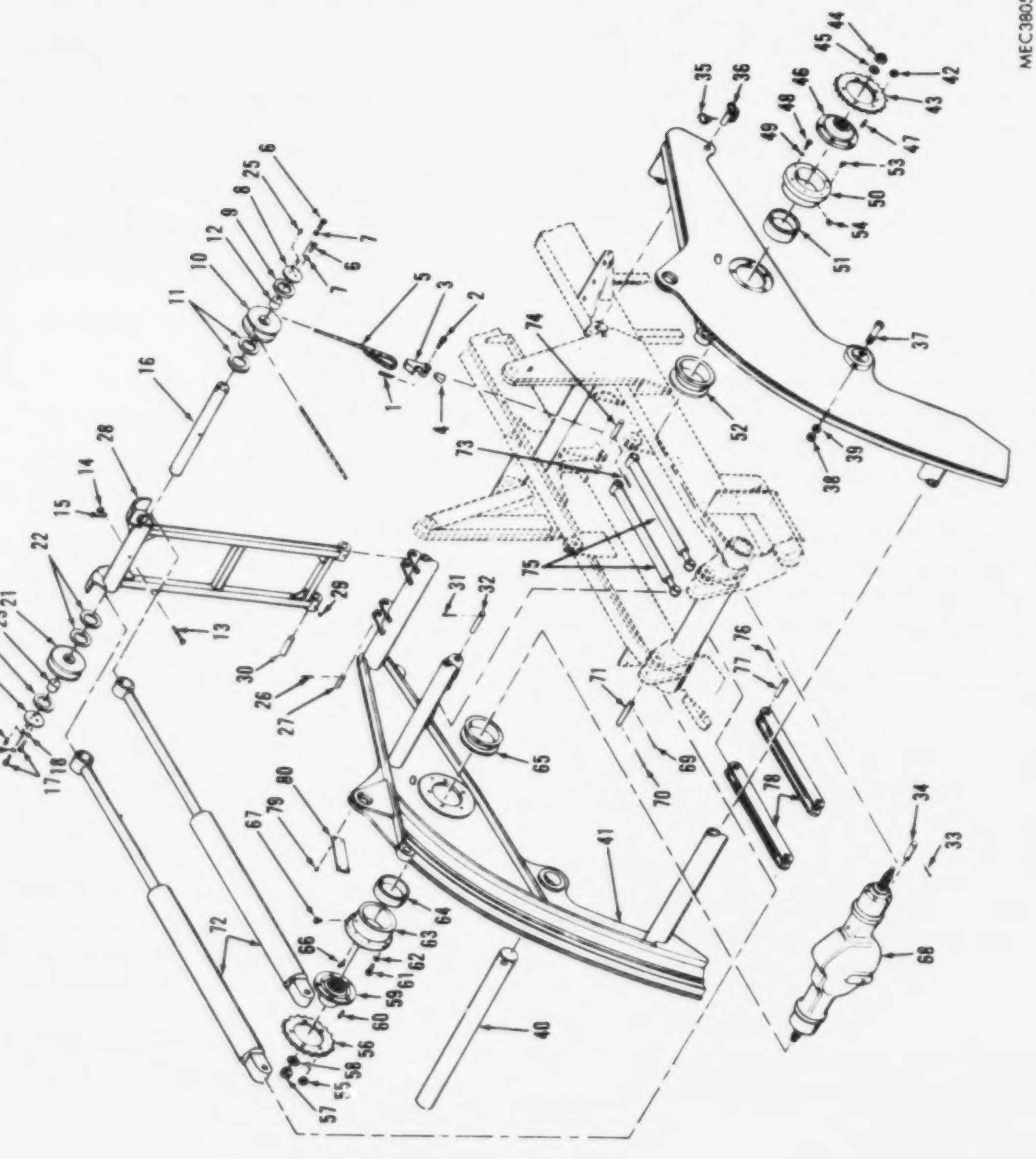
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Figure 14-4. Boom guide and hoist assembly, exploded view.

1 Cotter pin (2 rqr)
2 Clevis pin (2 rqr)
3 Socket (2 rqr)
4 Wedge (2 rqr)
5 Cable
6 Bolt, 1/2-13 x 1 1/4 in. (2 rqr)
7 Lockwasher, 1/2 in. (2 rqr)
8 End plate
9 Spacer
10 Sheave
11 Spacer
12 Bushing
13 Bolt, 1/2-13 x 5 in.
14 Nut, 1/2-13
15 Lockwasher, 1/2 in.
16 Shaft
17 Bolt, 1/2-13 x 1 1/4 in. (2 rqr)
18 Lockwasher, 1/2 in. (2 rqr)
19 End plate
20 Spacer
21 Sheave
22 Spacer (2 rqr)
23 Bushing
24 Grease fitting
25 Grease fitting
26 Cotter pin (4 rqr)
27 Pin (2 rqr)
28 Mast
29 Grease fitting (2 rqr)
30 Bushing (2 rqr)
31 Cotter pin (4 rqr)
32 Pin (2 rqr)
33 Cotter pin (4 rqr)
34 Pin (2 rqr)
35 Retainer pin (2 rqr)
36 Boom lock (2 rqr)
37 Bolt, 3/4-10 x 8 in.
38 Nut, 3/4-10
39 Jam nut, 3/4-10
40 Shaft
41 Bearing guide assembly
42 Locknut, 5/8-18 (5 rqr)
43 Sprocket
44 Locknut, 1 1/4-12
45 Washer, 1 1/4 in.
46 Hub
47 Stud (5 rqr)
48 Bolt, 3/4-10 x 1 3/4 in. (6 rqr)
49 Lockwasher, 3/4 in. (6 rqr)
50 Flange bearing
51 Bushing
52 Bushing
53 Grease fitting
54 Plug
55 Locknut, 5/8-18 (5 rqr)
56 Sprocket
57 Locknut, 1 1/4-12
58 Washer, 1 1/4 in.
59 Hub
60 Stud (5 rqr)
61 Bolt, 3/4-10 x 1 3/4 in. (6 rqr)
62 Lockwasher, 3/4 in. (6 rqr)
63 Flange bearing
64 Bushing
65 Bushing
66 Grease fitting
67 Plug
68 Sprocket drive assembly
69 Cotter pin, short (2 rqr)
70 Cotter pin, long (2 rqr)
71 Pin (2 rqr)
72 Hoist cylinder (2 rqr)
73 Cotter pin (4 rqr)
74 Pin (2 rqr)
75 Tilt cylinder (2 rqr)
76 Cotter pin (4 rqr)
77 Pin (2 rqr)
78 Leveling link (2 rqr)
79 Drive screw (4 rqr)
80 Nameplate

Figure 14-4—Continued

CHAPTER 15

MAIN FRAME AND SHEET METAL REPAIR INSTRUCTIONS

Section I. SHEET METAL

15–1. General

This section covers the repair of all sheet metal components of the ditching machine. These components are listed on figure 15–1.

15–2. Removal

a. Refer to chapters 4, 5, 7, 9 and 11 and remove all electrical, pneumatic, and hydraulic fittings and lines.

b. Refer to TM 5–3805–240–12 and remove radiator grille.

c. Remove sheet metal components and attached hardware in the numerical sequence as illustrated on figure 15–1.

15–3. Cleaning

Refer to TM 5–3805–240–12 and clean the sheet metal components.

15–4. Inspection and Repair

a. Inspect each sheet metal component for bent, cracked, or broken structural members. Restore bent sections to original shape in accordance with TM 10–450. Repair all cracks or breaks by welding, performed in compliance with MIL–STD–1261, and table 15–1.

Caution: **Bake or store all covered, low-hydrogen electrodes according to manufacturer's instructions (usually 1 hour baking at 800° F and storage in a holding oven at 250 + 25° F) to assure a moisture content less than 0.2 percent to prevent cracking in welds. Keep wire-flux combinations clean and dry; discard if exposed to water, grease, or dirt.**

b. Inspect each component for paint damage. Paint exposed metal surfaces as required by MIL–T–704.

15–5. Installation

a. Install sheet metal components and attached hardware in reverse of the numerical sequence as illustrated on figure 15–1.

b. Refer to TM 5–3805–240–12 and install radiator grille.

c. Refer to chapters 4, 5, 7, 9 and 11 and install all electrical, pneumatic, and hydraulic fittings and lines.

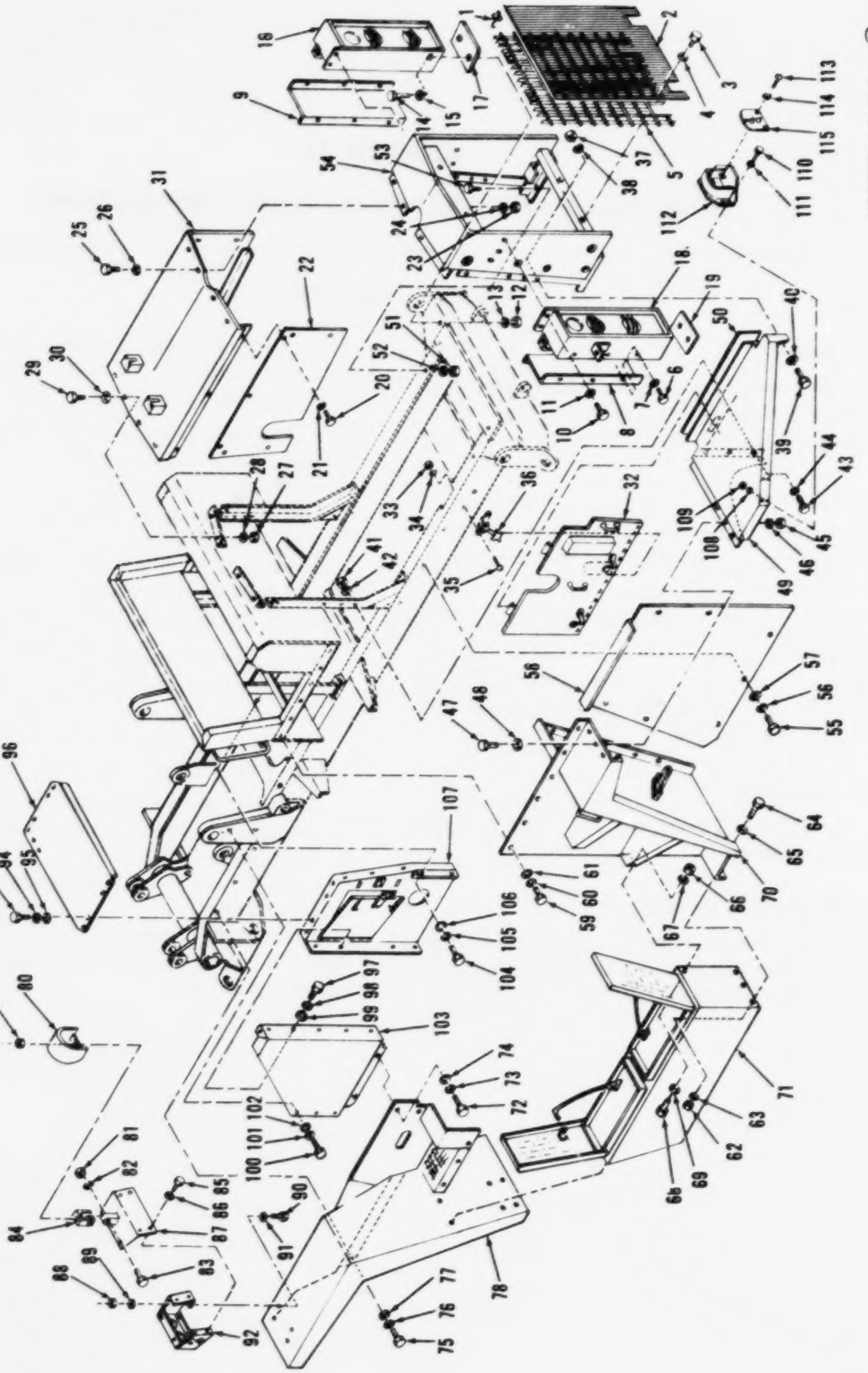
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Figure 15-1. Sheet metal components, exploded view (sheet 1 of 3).

1 Wire, 12–16 ga. x 5 in. (12 rqr)
2 Screen
3 Screw, 3/8–16 x 1 1/4 in. (4 rqr)
4 Washer, lock, 3/8 in. (4 rqr)
5 Grille
6 Screw, 1/4–20 x 1/2 in. (12 rqr)
7 Washer, flat, 1/4 in. (12 rqr)
8 Cover, headlight housing
9 Cover, headlight housing
10 Screw, 3/8–16 x 3/4 in. (4 rqr)
11 Washer, flat, 3/8 in. (4 rqr)
12 Nut, 3/8–16 (4 rqr)
13 Washer, 3/8 in.
14 Screw, 3/8–16 x 1 in.
15 Washer, flat, 3/8 in.
16 Housing headlight, R.H.
17 Filler, headlight housing
18 Housing headlight, L.H.
19 Filler, headlight housing
20 Screw, 3/8–16 x 1/2 in. (3 rqr)
21 Washer, lock, 3/8 in. (3 rqr)
22 Panel, hood, R.H.
23 Nut, 3/8–16 (8 rqr)
24 Washer, lock, 3/8 in. (8 rqr)
25 Screw, 3/8–16 x 3/4 in. (8 rqr)
26 Washer, flat, 3/8 in. (8 rqr)
27 Nut, 3/8–16 (8 rqr)
28 Washer, lock, 3/8 in. (8 rqr)
29 Screw, 3/8–16 x 3/4 in. (8 rqr)
30 Washer, flat, 3/8 in. (8 rqr)
31 Hood weldment
32 Panel weldment
33 Nut, No. 10–24 (8 rqr)
34 Washer, lock, No. 10 (8 rqr)
35 Screw, No. 10–24 x 7/8 in. (8 rqr)
36 Door catch (4 rqr)
37 Nut, 3/8–16 (4 rqr)
38 Washer, lock, 3/8 in. (4 rqr)
39 Screw, 3/8–16 x 3/4 in. (4 rqr)
40 Washer, flat, 3/8 in. (4 rqr)
41 Nut, 3/8–16 (4 rqr)
42 Washer, lock, 3/8 in. (4 rqr)
43 Screw, 3/8–16 x 1 1/4 in. (4 rqr)
44 Washer, flat 3/8 in. (4 rqr)
45 Nut, 3/8–16 (3 rqr)
46 Washer, lock, 3/8 in. (3 rqr)
47 Screw, 3/8–16 x 1 in. (3 rqr)
48 Washer, flat, 3/8 in. (3 rqr)
49 Fender, front, RH
50 Shim, fender (AR)
51 Nut, 5/8–11 (4 rqr)
52 Washer, lock, 5/8 in. (4 rqr)
53 Screw, 5/8–11 x 1 3/4 in. (4 rqr)
54 Radiator support
55 Screw, 3/8–16 x 1 in. (7 rqr)
56 Washer, lock, 3/8 in. (7 rqr)
57 Washer, flat, 3/8 in. (7 rqr)
58 Panel, front, RH
59 Screw, 3/8–16 x 1 in. (9 rqr)
60 Washer, lock, 3/8 in. (9 rqr)
61 Washer, flat, 3/8 in. (9 rqr)
62 Nut, 3/8–16 (8 rqr)
63 Washer, lock, 3/8 in. (8 rqr)
64 Screw, 3/8–16 x 1 in. (8 rqr)
65 Washer, flat, 3/8 in. (8 rqr)
66 Nut, 3/8–16 (2 rqr)
67 Washer, lock, 3/8 in. (2 rqr)
68 Screw, 3/8–16 x 1 in. (2 rqr)
69 Washer, flat, 3/8 in. (2 rqr)
70 Fender, center, RH
71 Battery box assembly
72 Screw, 3/8–16 x 3/4 in. (2 rqr)
73 Washer, lock, 3/8 in. (2 rqr)
74 Washer, flat, 3/8 in. (2 rqr)
75 Screw, 3/8–16 x 3/4 in. (8 rqr)
76 Washer, lock, 3/8 in. (8 rqr)
77 Washer, flat, 3/8 in. (8 rqr)
78 Fender, rear, RH
79 Nut (2 rqr)
80 Cover, flood light (2 rqr)
81 Nut (2 rqr)
82 Washer, lock (2 rqr)
83 Screw (2 rqr)
84 Holder (2 rqr)
85 Screw, 1/4–20 x 3/4 in. (16 rqr)
86 Washer, flat, 1/4 in. (16 rqr)
87 Cover, tail light housing, R.H.
88 Nut, 1/4–20 (16 rqr)
89 Washer, lock, 1/4 in. (16 rqr)
90 Screw, 1/4–20 x 3/4 in. (8 rqr)
91 Washer, flat, 1/4 in. (8 rqr)
92 Housing, tail light, RH
93 Screw, 3/8–16 x 3/4 in. (8 rqr)
94 Washer, lock, 3/8 in. (8 rqr)
95 Washer, flat, 3/8 in. (8 rqr)
96 Panel, top
97 Screw, 3/8–16 x 3/4 in. (5 rqr)
98 Washer, lock, 3/8 in. (5 rqr)
99 Washer, flat, 3/8 in. (5 rqr)
100 Screw, 3/8–16 x 3/4 in. (5 rqr)
101 Washer, lock, 3/8 in. (3 rqr)
102 Washer, flat, 3/8 in. (3 rqr)
103 Panel, rear, RH
104 Screw, 3/8–16 x 3/4 in. (2 rqr)
105 Washer, lock, 3/8 in. (2 rqr)
106 Washer, flat, 3/8 in. (2 rqr)
107 Panel, center, RH
108 Nut, 3/8–16 (8 rqr)
109 Washer, lock, 3/8 in. (8 rqr)
110 Screw, 3/8–16 x 3/4 in. (8 rqr)
111 Washer, flat, 3/8 in. (8 rqr)
112 Housing, clearance light (2 rqr)
113 Screw, No. 10–32 x 3/8 in. (6 rqr)
114 Washer, lock, No. 10 (6 rqr)
115 Mounting plate, clearance light (2 rqr)
116 Panel weldment, LH
117 Screw (4 rqr)
118 Cover, air inlet
119 Screw, 3/8–16 x 1 in. (7 rqr)
120 Washer, lock, 3/8 in. (7 rqr)
121 Washer, flat, 3/8 in. (7 rqr)
122 Panel, front, LH
123 Nut, 3/8–16 (3 rqr)
124 Washer, lock, 3/8–16 x 1 in. (3 rqr)
125 Screw, 3/8–16 x 1 in. (3 rqr)
126 Washer, flat, 3/8 in. (3 rqr)
127 Fender, front, LH
128 Nut, 3/8–16 (2 rqr)
129 Washer, lock, 3/8 in. (2 rqr)
130 Screw, 3/8–16 x 1 in. (2 rqr)
131 Washer, flat, 3/8 in. (2 rqr)
132 Screw, 3/8–16 x 1 in. (4 rqr)
133 Washer, lock, 3/8 in. (4 rqr)
134 Washer, flat, 3/8 in. (4 rqr)
135 Nut, 3/8–16 (8 rqr)
136 Screw, 3/8–16 x 1 in. (4 rqr)
137 Washer, lock, 3/8 in. (4 rqr)
138 Washer, flat, 3/8 in. (4 rqr)
139 Fender, bottom, LH
140 Screw, 3/8–16 x 3/4 in. (6 rqr)
141 Washer, lock, 3/8 in. (6 rqr)
142 Washer, flat, 3/8 in. (6 rqr)
143 Fender, center, LH
144 Screw, 3/8–16 x 3/4 in. (2 rqr)

Figure 15-1—Continued

145	Washer, lock, 3/8 in. (2 rqr)
146	Washer, flat, 3/8 in. (2 rqr)
147	Screw, 3/8-16 x 1 in. (4 rqr)
148	Washer, lock, 3/8 in. (4 rqr)
149	Washer, flat, 3/8 in. (4 rqr)
150	Fender, rear, LH
151	Nut, 3/8-16 (5 rqr)
152	Screw, 3/8-16 x 1 in. (5 rqr)
153	Washer, flat, 3/8 in. (5 rqr)
154	Washer, lock, 3/8 in. (5 rqr)
155	Screw, 3/8-16 x 3/4 in. (3 rqr)
156	Washer, lock, 3/8 in. (3 rqr)
157	Washer, flat, 3/8 in. (3 rqr)
158	Panel, rear, LH
159	Screw, 3/8-16 x 1 1/4 in. (2 rqr)
160	Washer, lock, 3/8 in. (2 rqr)
161	Washer, flat, 3/8 in. (2 rqr)
162	Screw, 3/8-16 x 1 in. (6 rqr)
163	Washer, lock, 3/8 in. (6 rqr)
164	Washer, flat, 3/8 in. (6 rqr)
165	Control panel
166	Screw, 3/8-16 x 1 1/4 in. (2 rqr)
167	Washer, lock, 3/8 in. (2 rqr)
168	Washer, flat, 3/8 in. (2 rqr)
169	Cover, fuel gage
170	Nut, No. 10-24
171	Washer, lock, No. 10
172	Clamp (2 rqr)
173	Screw, No. 10-24 x 1 1/2 in. (2 rqr)
174	Screw, 3/8-16 x 1 1/4 in. (2 rqr)
175	Washer, lock, 3/8 in. (2 rqr)
176	Nut, 3/8-16 (2 rqr)
177	Cover, fuel filler cap
178	Screw, 3/8-16 x 3/4 in. (2 rqr)
179	Washer, lock, 3/8 in. (2 rqr)
180	Washer, flat, 3/8 in. (2 rqr)
181	Shield
182	Screw, 1/4-20 x 3/4 in. (11 rqr)
183	Washer, lock, 1/4 in. (11 rqr)
184	Washer, flat, 1/4 in. (11 rqr)
185	Floor plate, RH
186	Floor plate, LH
187	Nut, 1/4-20 (5 rqr)
188	Washer, lock, 3/8 in. (11 rqr)
189	Mount, resilient (5 rqr)
190	Screw, 1/4-20 x 5/8 in. (5 rqr)
191	Washer, flat, 1/4 in. (5 rqr)
192	Panel, instrument
193	Screw, 3/8-16 x 1/2 in. (6 rqr)
194	Washer, lock, 3/8 in. (6 rqr)
195	Bracket, rear view mirror, RH Bracket, rear view mirror, LH
196	Screw, 3/8-16 x 1/2 in. (14 rqr)
197	Washer, lock, 3/8 in. (14 rqr)
198	Pad, felt
199	Windshield assembly
200	Nut, 5/8-11 (4 rqr)
201	Washer, lock, 5/8 in. (4 rqr)
202	Screw, 5/8-11 x 1 1/2 in. (4 rqr)
203	Screw, 5/8-11 x 1 1/2 in. (4 rqr)
204	Washer, lock, 5/8 in. (4 rqr)
205	Cab frame weldment
206	Screw, 5/8-11 x 1 1/2 in. (2 rqr)
207	Washer, lock, 5/8 in. (2 rqr)
208	Screw, 5/8-11 x 1 1/2 in. (3 rqr)
209	Washer, lock, 5/8 in. (3 rqr)
210	Weldment, control panel
211	Spring, helical (2 rqr)
212	Nut, hex, 10-32 (4 rqr)
213	Washer, lock, No. 10 (4 rqr)
214	Screw, machine, 10-32 x 5/8 in. (4 rqr)
215	Washer, flat, No. 10 (4 rqr)
216	Vent assembly (2 rqr)
217	Handle (2 rqr)
218	Nut, jam, 1/4-20 (2 rqr)
219	Nut, jam, 1/4-20 (2 rqr)
220	Bolt, 1/4-20 x 3/4 (2 rqr)
221	Door holder (2 rqr)
222	Nut, hex, 10-32 (6 rqr)
223	Washer, lock, No. 10 (6 rqr)
224	Screw, machine, 10-32 x 5/8 in. (6 rqr)
225	Washer, flat, No. 10 (6 rqr)
226	Bracket, LH Bracket, RH
227	Seal (2 rqr)
228	Curtain stud, No. 10-32 (6 rqr)
229	Nut, hex, No. 8-32 (27 rqr)
230	Washer, lock, No. 8-32 (27 rqr)
231	Curtain stud, No. 8-32 (27 rqr)

Figure 15-1—Continued

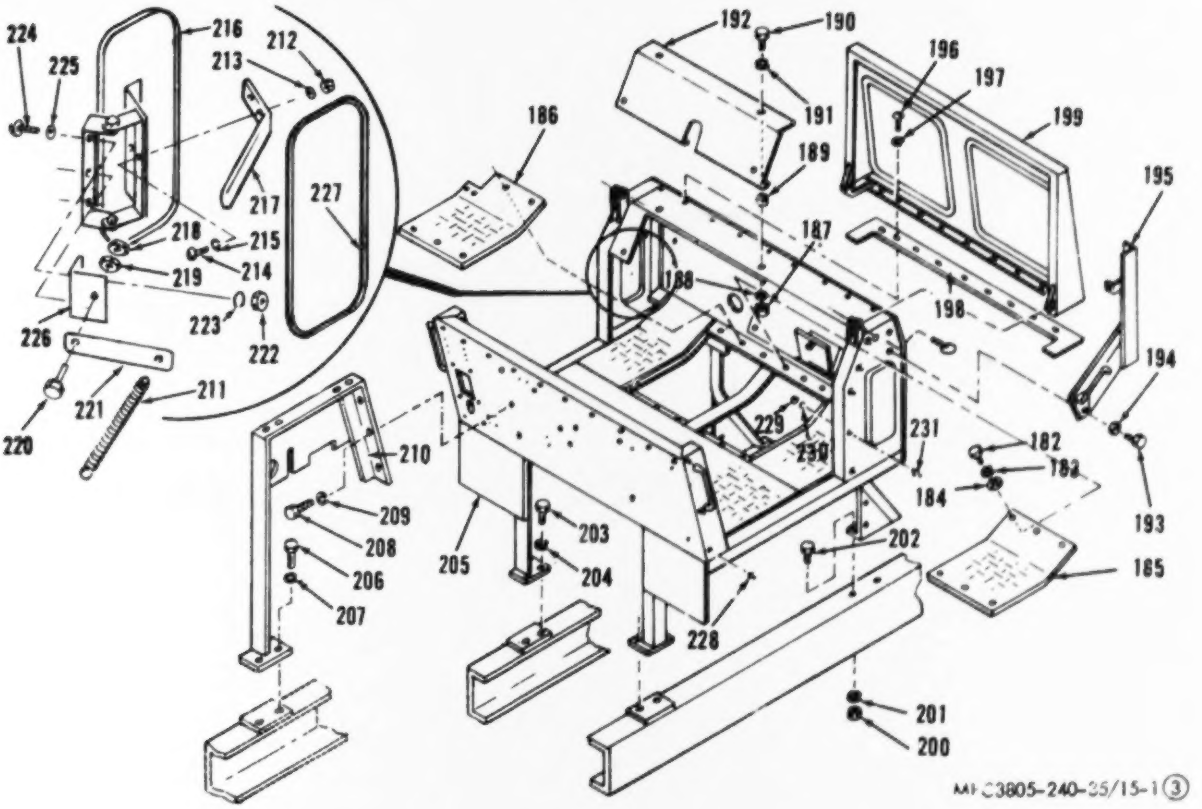
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Figure 15-1. Sheet metal components, exploded view (sheet 3 of 3).

Section II. MAIN FRAME

15-6. General

a. This section covers the repair of the main frame of the ditching machine. The main frame is constructed of plate and channel steel welded to and braced by structural angles, (fig. 15-2).

b. Figure 15-3 shows the high-strength constructional steel components.

Note. Although the digging boom assembly general repair instructions are covered in paragraphs 14-5, 14-17, 14-24, and 14-31, table 15-1 contains a special data for high strength constructional steel welding repairs. See figure 15-3 for the components affected.

15-7. Removal

Remove main frame by removing all attached components.

15-8. Cleaning

Clean main frame with an approved solvent

15-9. Inspection and Repair

a. Inspect each component for bent, cracked or broken areas. Restore bent sections to original shape in accordance with TM 10-450. Repair all cracks or breaks by welding performed in compliance with MIL-STD-1261 and table 15-1.

b. Inspect each member for paint damage. Paint exposed metal surfaces as required by MIL-T-704 using finish color X24087.

Table 15-1. Welding Procedures

COMPONENT(S): *Digging Boom Assembly (1, 2, 3, figure 15-3). TYPE STEEL: T-1, or equivalent.				AN/ASTM CLASS: A—514 Grade F A—517 Grade F
Approved welding Processes:	Shielded metal-arc (manual-arc) welding	Gas-shielded metal-arc welding	Submerged—Arc welding	
			Alloy wire neutral flux	Carbon wire alloy flux
Filler Metal:				
Electrode Type/Class	AWSE11018			
Electrode Brand Name				
Wire— Type/Class				
Wire— Brand Name		AIRCO A-632	Linde Oxweld	Lincoln L61
Gas or flux: Type/Class				
Gas or flux: Brand Name		Argon w/1%0	Linde 709-5	Lincoln A0905-10
TRAVEL SPEED:				
1/2" thickness				
1" thickness				
1 3/4" thickness				
Number of Passes:				
Min. Ambient Temp:	50°F	50°F	50°F	50°F
MIN/MAXPREHEAT—INTERPASS TEMP:**				
1/2" thickness	50°F/400°F	50°F/400°F	50°F/400°F	50°F/400°F
1" thickness	50°F/400°F	50°F/400°F	50°F/400°F	200°F/400°F
1 3/4" thickness	50°F/400°F	50°F/400°F	50°F/400°F	300°F/400°F
Arc Current:				
1/2" thickness				
1" thickness				
1 3/4" thickness				
Arc Voltage:				
1/2" thickness				
1" thickness				
1 3/4" thickness				
AC or DC Power (polarity, if DC)				

Pheheat & inter pass tem	Max welding heat input (°F)		
	Plate thickness, in.		
	1/2	1	1 3/4
70	70,000	any	any
150	62,000	188,000	any
200	56,000	173,000	any
300	47,000	126,000	any
	Joules/inch of weld		

COMPONENT(S): *Main Frame Channel Beams (4, Figure 15-8).
TYPE STEEL: U. S. Steel COR-TEN, or equivalent (0.475" web thickness)

Approved welding Processes:	Shielded metal-arc (manual-arc) welding	Gas-shielded metal-arc welding	AN/ASTM CLASS: Submerged—Arc welding: Alloy wire neutral flux	AN/ASTM CLASS: Submerged—Arc welding: Carbon wire alloy flux
FILLER METAL: Electrode— Type/Class Brand Name Wire— Type/Class Brand Name	E-60, 70/ASTMA233	E-60, 70/ASTMA233		2.5-3.5% Ni.
Travel Speed:				
Number of Passes:				
Min. Ambient Temp.	0°F	0°F	0°F	0°F
Min Base Metal Temp.	50°F	50°F	50°F	50°F
Min/Max**Preheat Temp.	50°F/350°F	50°F/350°F	50°F/350°F	50°F/350°F
Arc Current: .475" thickness				
Arc Voltage: .475" thickness				
AC or DC Power (polarity, if DCL)				

**Preheat structural members above the minimum (but below max.) temperatures shown whenever field damage conditions may require highly restrained welding repairs, or whenever ambient temperatures are lower than minimums shown.

Preheat local areas to remove moisture from steel, as required.

Do not post-heat.

Max welding heat input (°F)			
Preheat & Interpass temp	Plate thickness, in.		
	.475	xxxx	xxxx
Joules/inch of weld			

Remove scale and rust by acid pickling, grit or shot blasting, or wire brushing. Never let the surface area show red, if flame descaling must be used.

Weld using stringer bead technique.

*High-strength constructional steel.

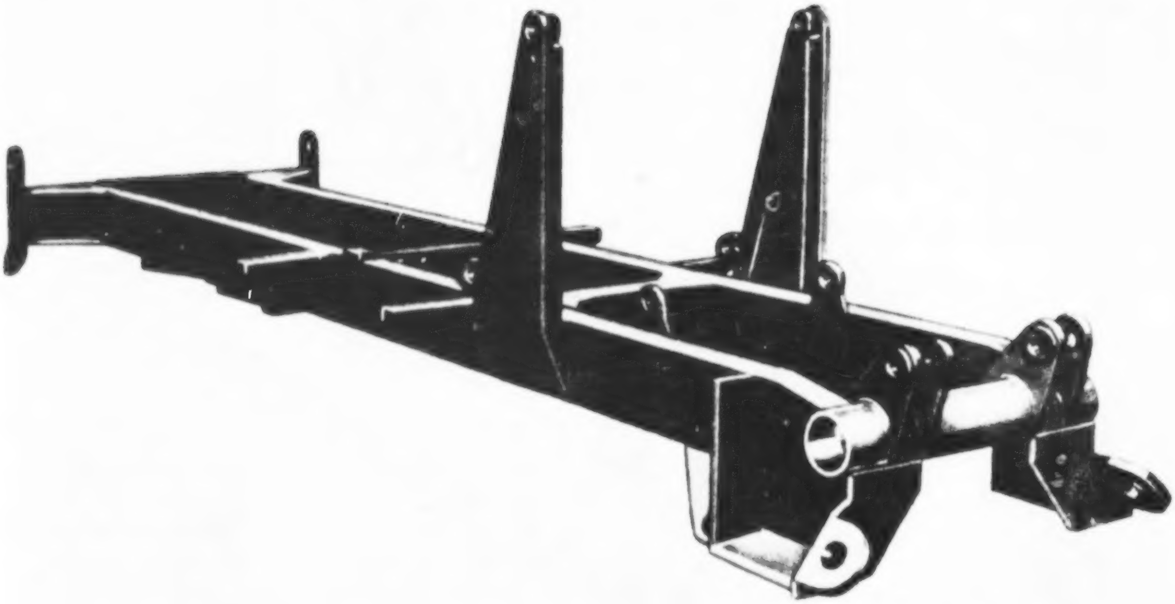

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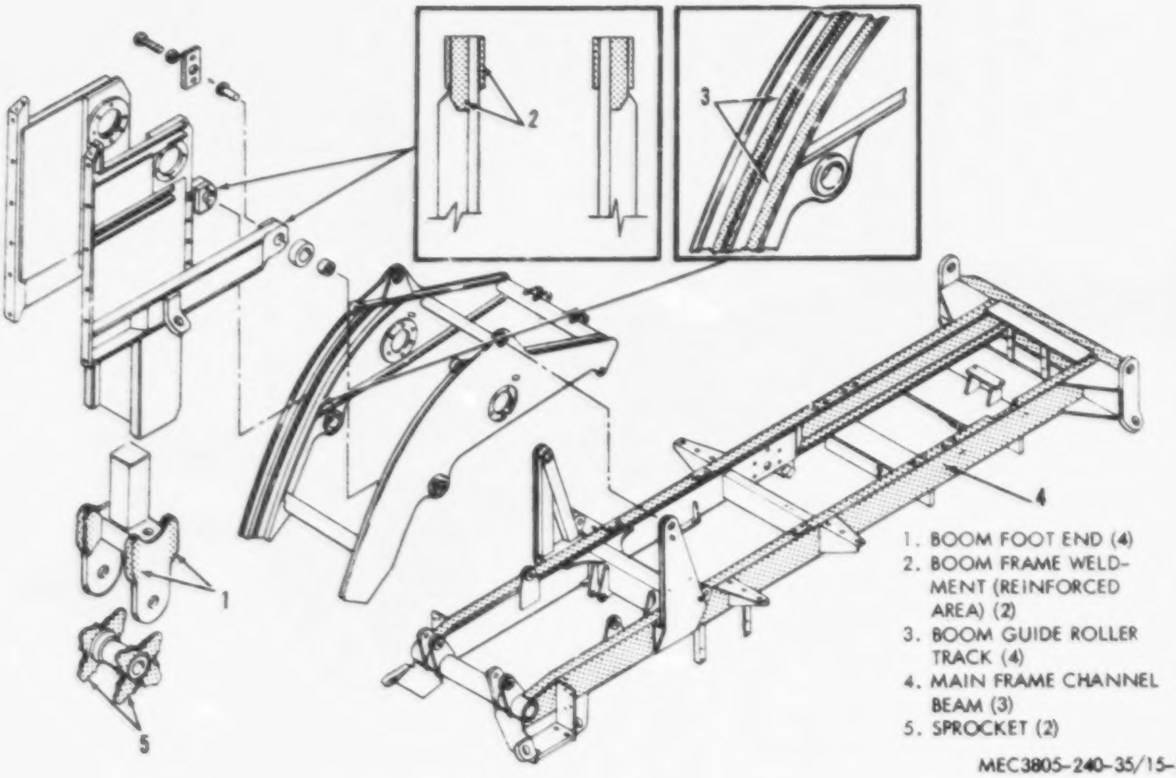
Figure 15-2. Main frame.



1. BOOM FOOT END (4)
2. BOOM FRAME WELDMENT (REINFORCED AREA) (2)
3. BOOM GUIDE ROLLER TRACK (4)
4. MAIN FRAME CHANNEL BEAM (3)
5. SPROCKET (2)

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Figure 15–3. High strength constructional steel components.

APPENDIX A

REFERENCES

A-1. Fire Protection

TB 5-4200-200-10	Hand Portable Fire extinguishers Approved for Army Users

A-2. Lubrication

C91001L	Fuels Lubricants, Oils and Waxes
LO 5-3805-240-12	Lubrication Order

A-3. Painting

TM 9-213	Painting Instructions for Field Use

A-4. Maintenance

TM 9-1870-1	Care and Maintenance of Pneumatic Tires
TB ORD 651	Use of Antifreeze solutions and Cleaning Compounds in engine cooling systems
TB 38-750	Army Equipment Maintenance Procedures
TM 5-3805-240-20P	Organizational Repair Parts Manual (When Printed)
TM 5-3805-240-35P	Direct & General Support & Depot Maintenance Repair Parts Manual (When Printed)
TM 5-3805-240-12	Organizational Maintenance Manual
TM 9-6140-200-15	Operation and Organizational Field and Depot Maintenance Storage Batteries, Lead Acid Type.
TM 10-450	Sheet Metal Work; Body, Fender and Radiator Repairs
TM 9-214	Inspection, Care and Maintenance of Antifrication Bearings
TM 9-8621	Power Train Components
TM 10-269	General Repair for Canvas & Webbing
TM 5-764	Electric Motor and Generator Repair

A-5. Shipment and Storage

TB 740-93-2	Preservation of USAMEC Mechanical Equipment for Shipment and Storage
TM 740-90-1	Administrative Storage of Equipment

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By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:

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Major General, United States Army,
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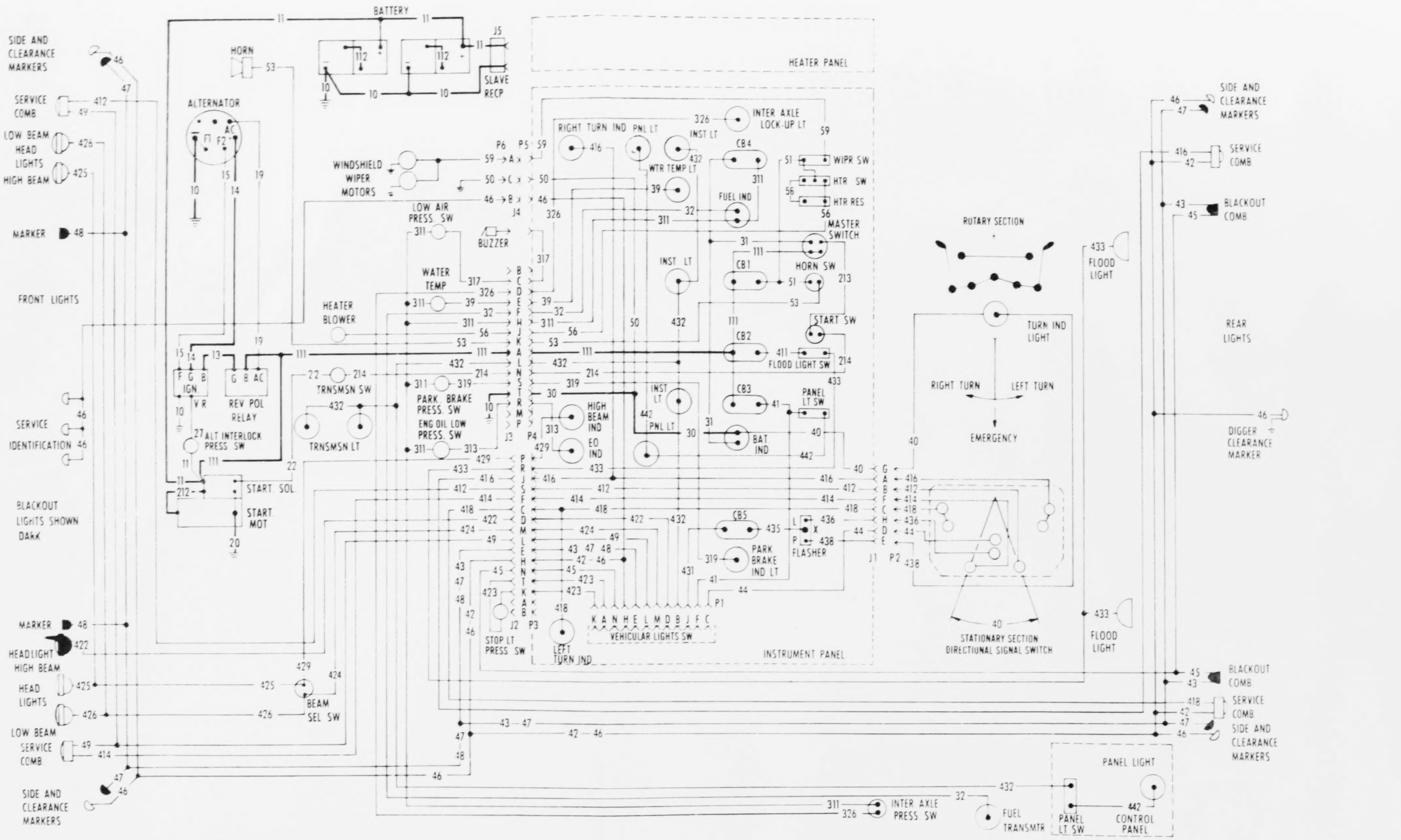
BATTERY
HEATER PANEL
SLAVE RECP
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HORN
SIDE AND CLEARANCE MARKERS
SERVICE COMB
LOW BEAM HEAD LIGHTS HIGH BEAM
MARKER
FRONT LIGHTS
ALTERNATOR
WINDSHIELD WIPER MOTORS
LOW AIR PRESS. SW
BUZZER
WATER TEMP
HEATER BLOWER
TRNSMSN SW
TRNSMSN LT
PARK. BRAKE PRESS. SW
ENG OIL LOW PRESS. SW
IGN
V R
REV POL RELAY
ALT INTERLOCK PRESS SW
START SOL
START MOT
SERVICE
IDENTIFICATION
BLACKOUT LIGHTS SHOWN DARK
HEADLIGHT HIGH BEAM
HEAD LIGHTS
LOW BEAM
BEAM SEL SW
STOP LT PRESS SW
LEFT TURN IND
VEHICULAR LIGHTS SW
INSTRUMENT PANEL
RIGHT TURN IND
PNL LT
INST LT
INTER AXLE LOCK-UP LT
WTR TEMP LT
CB4
FUEL IND
CB1
HORN SW
MASTER SWITCH
WIPR SW
HTR SW
HTR RES
START SW
CB2
FLOOD LIGHT SW
CB3
PANEL LT SW
BAT IND
HIGH BEAM IND
EO IND
CB5
PARK BRAKE IND LT
FLASHER
ROTARY SECTION
TURN IND LIGHT
RIGHT TURN
LEFT TURN
EMERGENCY
STATIONARY SECTION DIRECTIONAL SIGNAL SWITCH
FLOOD LIGHT
REAR LIGHTS
BLACKOUT COMB
DIGGER CLEARANCE MARKER
PANEL LIGHT
PANEL LT SW
CONTROL PANEL
INTER AXLE PRESS SW
FUEL TRANSMTR
P1
P2
P3
P4
P5
P6
J1
J2
J4

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Figure 1-2. Electrical wiring diagram.

Figure 1-2.

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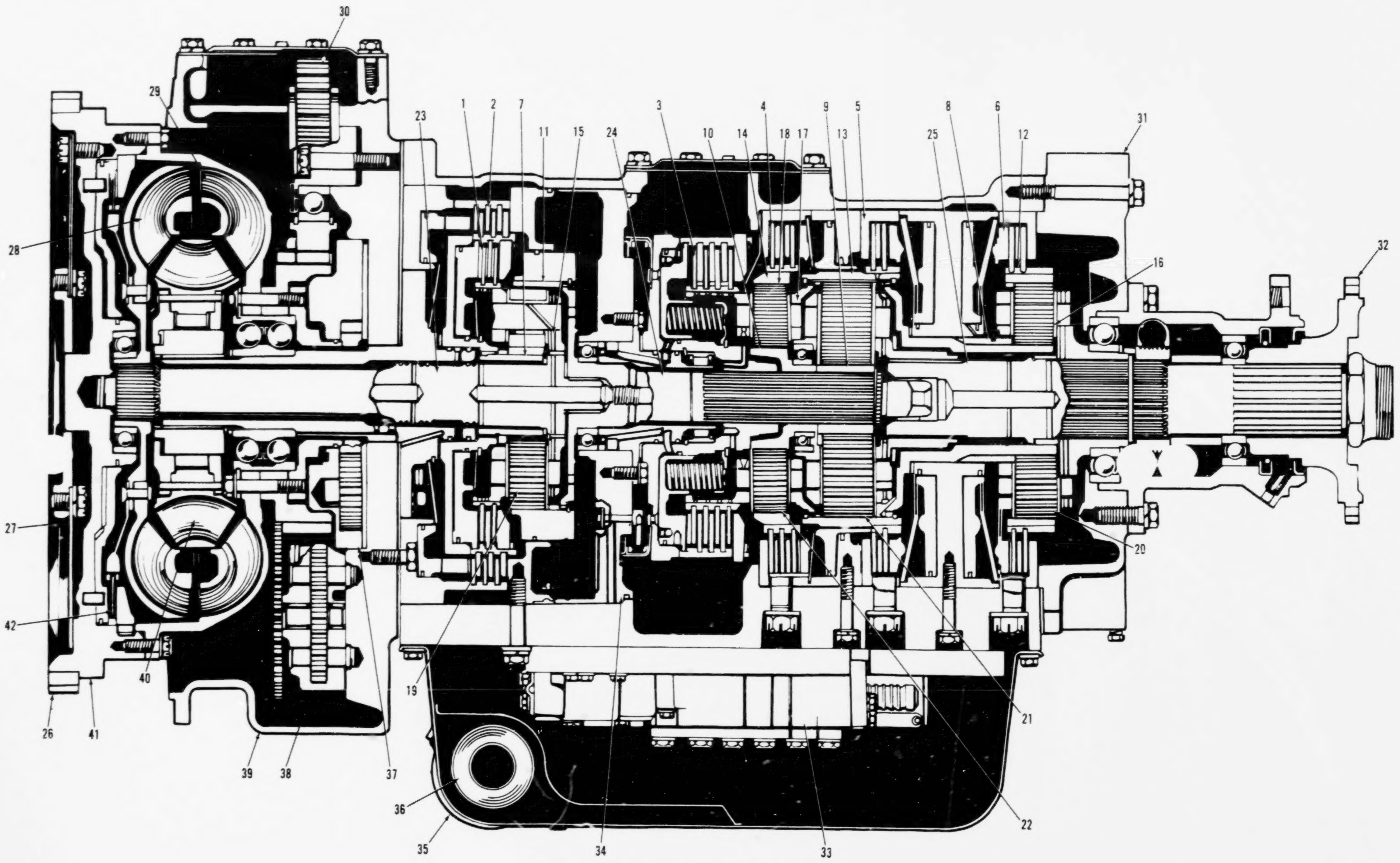

1	Splitter direct-drive clutch pack
2	Splitter overdrive clutch pack
3	High-range clutch pack
4	Intermediate-range clutch pack
5	Low-range clutch pack
6	Reverse-range clutch pack
7	Splitter sun gear
8	Reverse-range sun gear
9	Low-range sun gear
10	Intermediate-range sun gear
11	Splitter ring gear
12	Reverse-range ring gear
13	Low-range ring gear
14	Intermediate-range ring gear
15	Splittter planet carrier
16	Reverse-range planet carrier
17	Low-range planet carrier
18	Intermediate-range planet carrier
19	Splitter planet pinion
20	Reverse-range planet pinion
21	Low-range planet pinion
22	Intermediate-range planet pinion
23	Turbine shaft
24	Splitter output shaft
25	Output shaft
26	Starter ring gear
27	Flex disc assembly
28	Torque converter turbine assembly
29	Torque converter pump assembly
30	Engine-driven power take-off gear
31	Transmission rear cover
32	Transmission output flange
33	Control valve assembly and converter pressure regulator valve assembly
34	Governor
35	Oil pan
36	Oil screen
37	Charging oil pump
38	Scavenge oil pump
39	Torque converter housing
40	Stator assembly
41	Flywheel
42	Lockup clutch assembly

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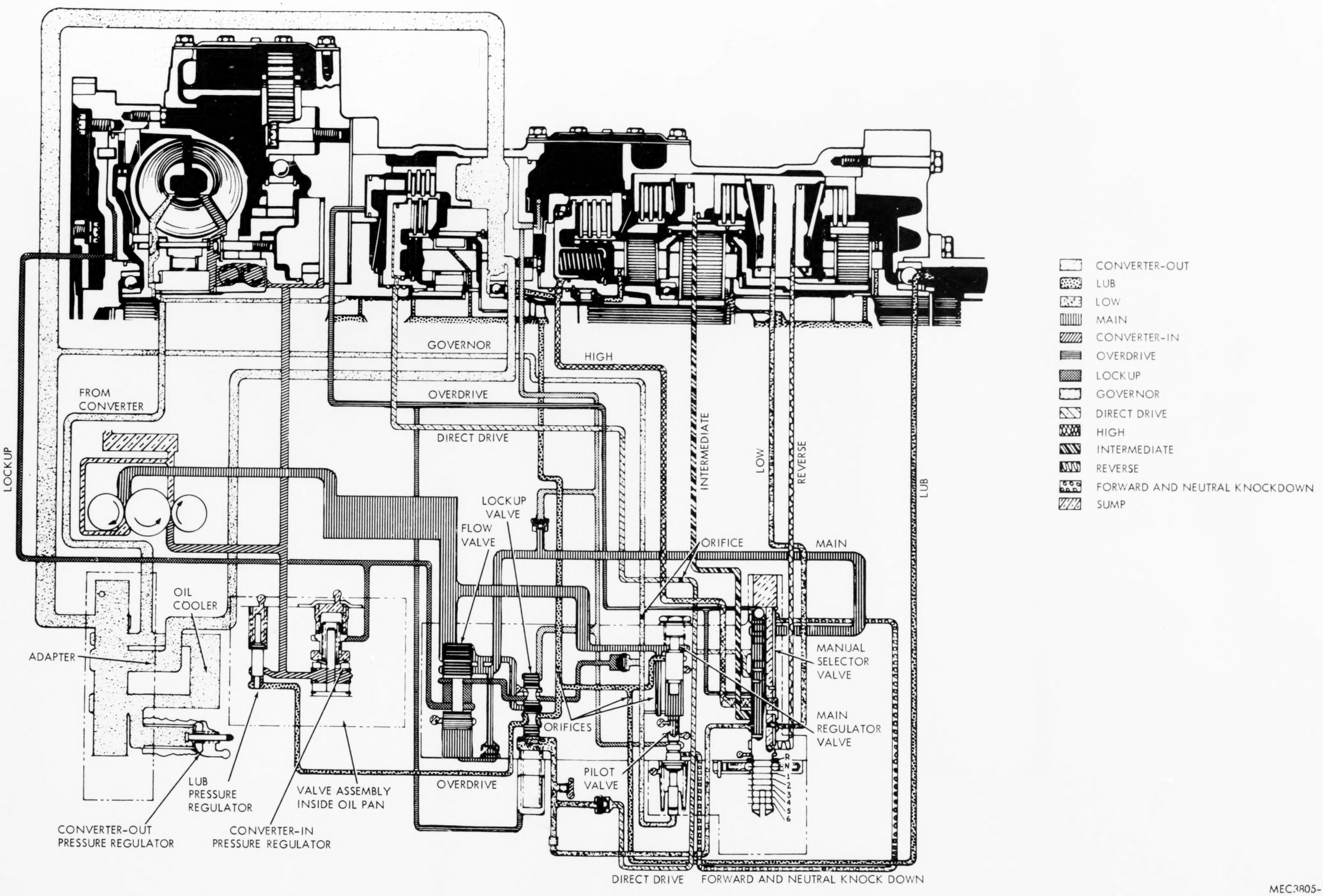
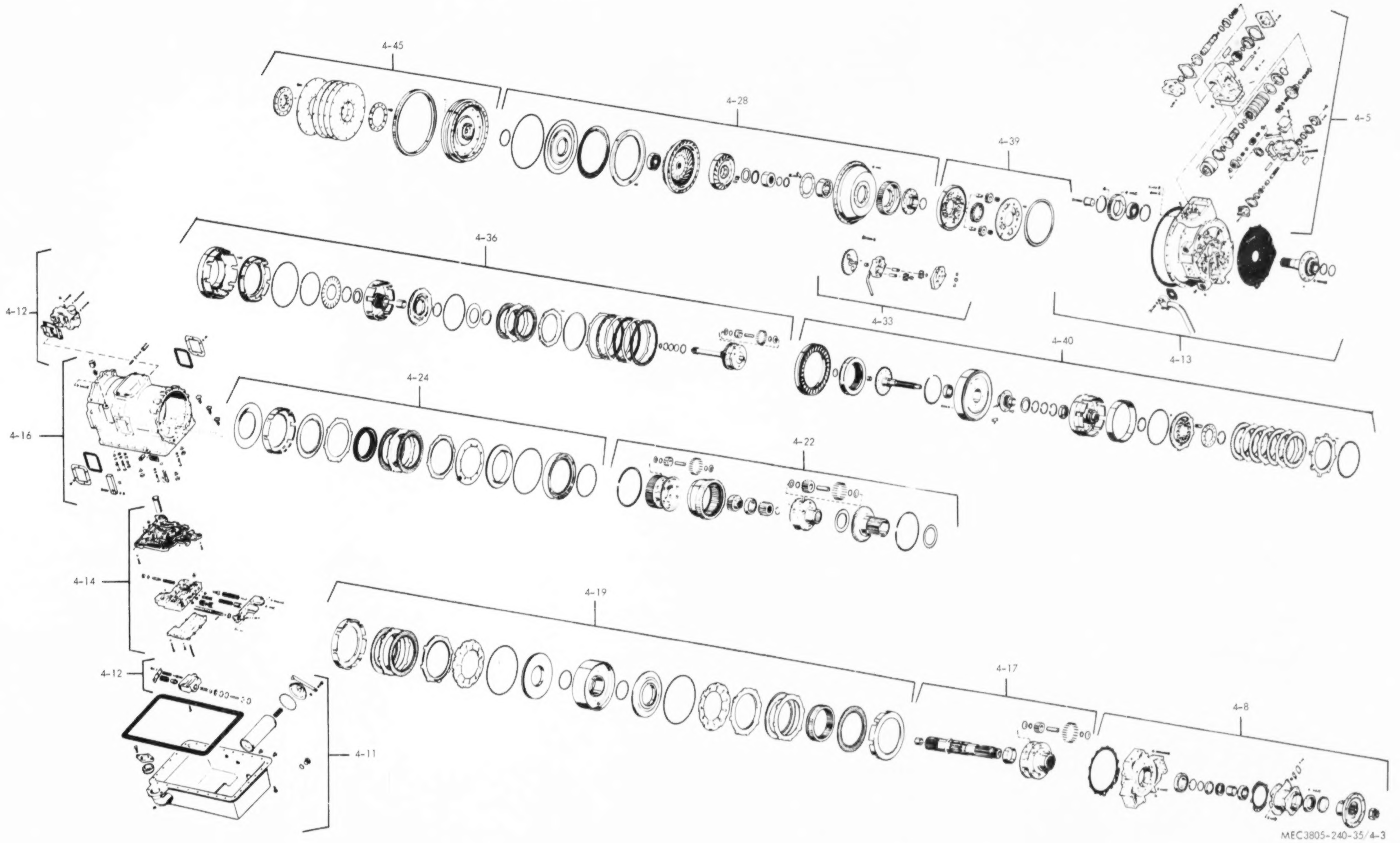
Figure 4-1. Transmission/torque converter, cross-section view.

Figure 4-1.


GOVERNOR
HIGH
FROM CONVERTER
OVERDRIVE
DIRECT DRIVE
LOCKUP
INTERMEDIATE
LOW
REVERSE
LUB
LOCKUP VALVE
FLOW VALVE
ORIFICE
MAIN
OIL COOLER
ADAPTER
MANUAL SELECTOR VALVE
ORIFICES
MAIN REGULATOR VALVE
PILOT VALVE
OVERDRIVE
R
N
1
2
3
4
5
6
LUB PRESSURE REGULATOR
VALVE ASSEMBLY INSIDE OIL PAN
CONVERTER-OUT PRESSURE REGULATOR
CONVERTER-IN PRESSURE REGULATOR
DIRECT DRIVE
FORWARD AND NEUTRAL KNOCK DOWN
CONVERTER-OUT
LUB
LOW
MAIN
CONVERTER-IN
OVERDRIVE
LOCKUP
GOVERNOR
DIRECT DRIVE
HIGH
INTERMEDIATE
REVERSE
FORWARD AND NEUTRAL KNOCKDOWN
SUMP

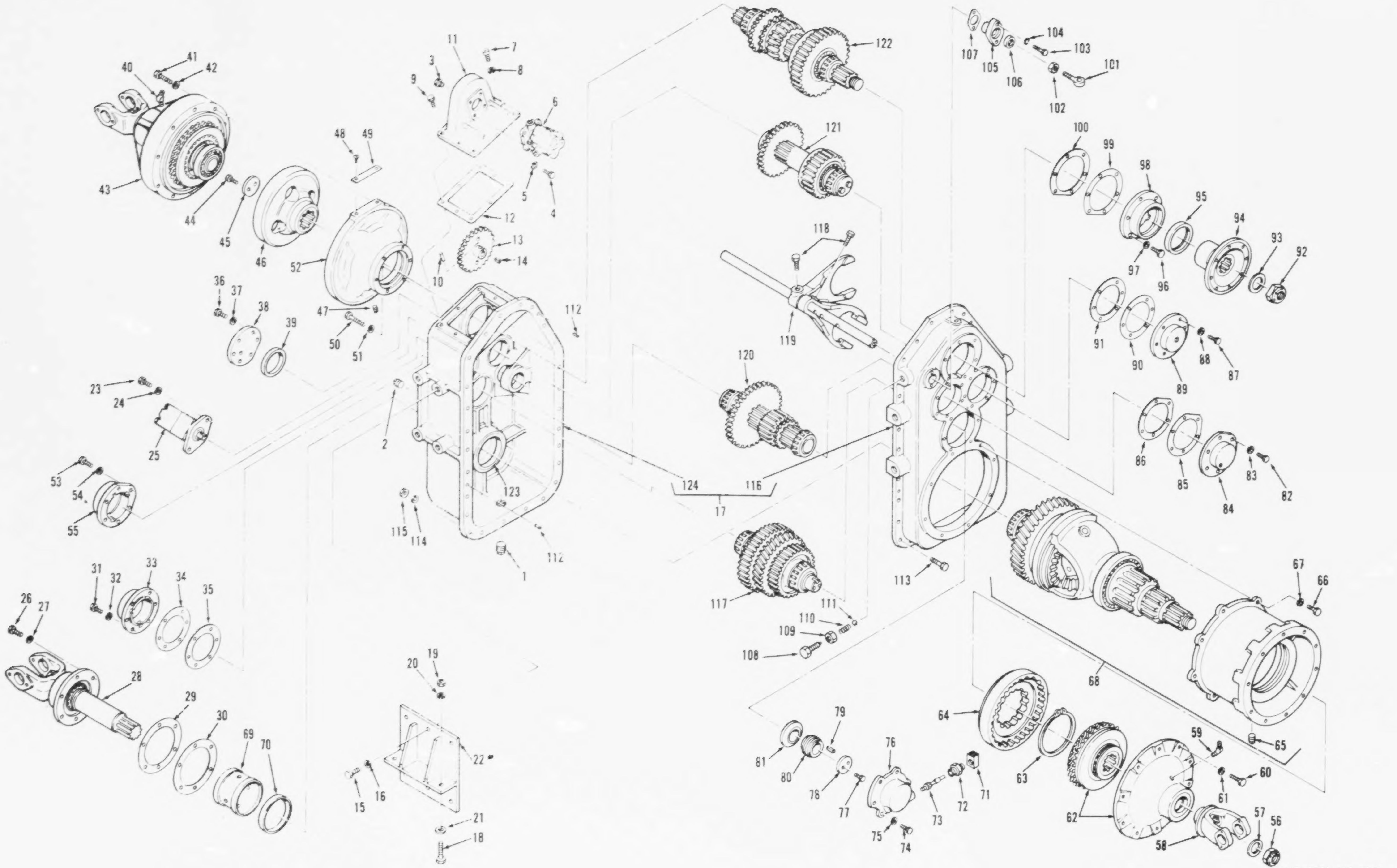
MEC3805-240-35/4-2

Figure 4-2. Transmission/torque converter flow diagram.



4-5	Power take-off assembly, exploded view
4-8	Transmission rear cover and output flange assemblies, exploded view
4-11	Transmission oil pan assembly, exploded view
4-12	Converter pressure regulator valve assembly and adapter assembly, exploded view
4-13	Torque converter housing and power take-off gear assembly, exploded view
4-14	Transmission control valve assembly and oil transfer plate assembly, exploded view
4-16	Transmission main housing assembly, exploded view
4-17	Transmission reverse-range planetary and output shaft assembly, exploded view
4-19	Transmission low-and reverse-range clutch assemblies, exploded view
4-22	Transmission intermediate-and low-range planetary assemblies, exploded view
4-24	Transmission intermediate-range clutch assembly, exploded view
4-28	Torque converter and lockup clutch assemblies, exploded view
4-33	Transmission/torque converter oil scavenge pump assembly, exploded view
4-36	Transmission splitter planetary and clutch assemblies, exploded view
4-39	Transmission/torque converter charging oil pump assembly, exploded view
4-40	Transmission splitter shaft and high-range clutch assembly, exploded view
4-45	Flex disc and flywheel assemblies, exploded view

Figure 4-3. Transmission/torque converter/power take-off sub-assembly groups, exploded view (reference numbers refer to sub-assembly figures).



MEC3805-240-35/5-4

Figure 5-4. Transfer case and subassemblies.

1	Plug, magnetic pipe
2	Plug, pipe
3	Fitting, pressure relief
4	Screw, cap, 5/16–18 x 3/4 in. (4 rqr)
5	Washer, lock, 5/16 (4 rqr)
6	Pump assembly, lube oil
7	Screw, cap, 3/8–16 (6 rqr)
8	Washer, lock, 3/8 in. (8 rqr)
9	Screw, cap, 3/8–16 x 1 in., skt head (2 rqr)
10	Screw, set
11	Housing, gear
12	Gasket
13	Gear, pump, 48T
14	Key, square
15	Screw, cap, 5/8 x 1 1/2 in., hex head (12 rqr)
16	Washer, lock, 5/8 (rqr)
17	Transfer case assembly
18	Screw, cap, 3/8–16 x 2 in., hex head (4 rqr)
19	Nut, hex, 3/8–16 (4 rqr)
20	Washer, lock, 3/8 in. (4 rqr)
21	Washer, plain, 3/8 in. (4 rqr)
22	Bracket, mounting
23	Screw, cap, 1/2 x 1 1/4 in., hex head (2 rqr)
24	Washer, lock, 1/2 in. (2 rqr)
25	Motor, crowd drive
26	Screw, cap, 3/8 x 1 1/4 in. (6 rqr)
27	Washer, lock, 3/8 in. (6 rqr)
28	Yoke, bearing retainer and rear output shaft V assembly
29	Shim, 0.005 in. (AR)
30	Shim, 0.020 in. (AR)
31	Screw, cap, 3/8–16 x 1 1/4 in. (6 rqr)
32	Washer, lock, 3/8 (6 rqr)
33	Cap, rear bearing, shaft IV
34	Shim, 0.005 in. (AR)
35	Shim, 0.020 in. (AR)
36	Screw, cap, 3/8–16 x 1 1/4 in. (6 rqr)
37	Washer, lock, 3/8 (6 rqr)
38	Cap, rear bearing, shaft II
39	Spacer
40	Elbow, 45°, tubing
41	Screw, cap, 7/16–14 x 1 1/2 in. (10 rqr)
42	Washer, lock, 7/16 in. (10 rqr)
43	Yoke, bucket line output shaft, and clutch assembly
44	Screw, cap, hex head, 7/16–14 x 1 in. (2 rqr)
45	Plate, end
46	Disc, outer ring clutch
47	Plug, magnetic pipe, 1/2 NPT
48	Screw (2 rqr)
49	Nameplate
50	Screw, 7/16–14 x 1 1/2 in. (6 rqr)
51	Washer, lock, 7/16 in. (6 rqr)
52	Housing, bucket line output shaft
53	Screw, cap, 3/8–16 x 1 1/4 in. (6 rqr)
54	Washer, lock, 3/8 in. (6 rqr)
55	Cap, shaft III rear bearing
56	Nut, 1 1/4 x 12 in.
57	Washer, 1 1/4 in.
58	Yoke, front output shaft V
59	Elbow, 45°, tubing
60	Screw, 7/16–14 x 1 1/2 in. (10 rqr)
61	Washer, lock, 7/16 in. (10 rqr)
62	Front clutch assembly
63	Ring, retaining
64	Disc, outer ring clutch
65	Plug, magnetic pipe
66	Screw, 1/2–13 x 1 1/2 in. (8 rqr)
67	Washer, lock, 1/2 in. (8 rqr)
68	Housing, differential and power divider assembly
69	Cup, power divider assembly rear bearing
70	Spacer, output shaft
71	Joint, right angle speedometer drive
72	Adapter, speedometer drive gear
73	Gear, speedometer driven
74	Screw, 7/16–14 x 1 1/4 in. (6 rqr)
75	Washer, lock, 7/16 (6 rqr)
76	Housing, speedometer gear
77	Screw, cap, 3/8–24 x 1 in. (2 rqr)
78	Plate, end
79	Key
80	Gear, speedometer drive
81	Spacer
82	Screw, 3/8–16 x 1 1/4 in. (6 rqr)
83	Washer, lock, 3/8 in. (6 rqr)
84	Cap, shaft III front bearing
85	Shim, 0.005 in. (AR)
86	Shim 0.020 in. (AR)
87	Screw, cap, 3/8–16 x 1 1/4 in. (6 rqr)
88	Washer, lock, 3/8 in. (6 rqr)
89	Cap, shaft II front bearing
90	Shim, 0.005 in. (AR)
91	Shim, 0.020 in. (AR)
92	Nut, esna, 1 1/2–12 in.
93	Washer, 1 1/2 in.
94	Flange, shaft I front input
95	Seal, oil
96	Screw, cap, 3/8–16 x 1 1/4 in. (6 rqr)
97	Washer, lock, 3/8 in. (6 rqr)
98	Retainer, shaft I front bearing
99	Shim, 0.005 in. (AR)
100	Shim 0.020 in. (AR)
101	End, shift rod
102	Nut, jam
103	Screw, 5/16–18 x 1 1/4 in. (2 rqr)
104	Washer, lock, 5/16 in.(2 rqr)
105	Guide, shift
106	Seal, oil
107	Gasket
108	Screw, cap, 1/2–13 x 2 1/2 in.
109	Nut, 1/2–13 in.
110	Spring, detent
111	Ball, detent
112	Pin, dowel (2 rqr)
113	Screw, 3/8–24 x 1 1/4 in. (26 rqr)
114	Washer, lock, 3/8 in. (26 rqr)
115	Nut, 3/8 in. (26 rqr)
116	Transfer case, front half
117	Countershaft assembly IV
118	Bolt, 7/16–20 x 0.81 in. (2 rqr)
119	Shift, shaft assembly
120	Countershaft assembly III
121	Countershaft assembly II
122	Countershaft assembly I
123	Bushings and bearing caps
124	Transfer case, rear half

Figure 5-4.

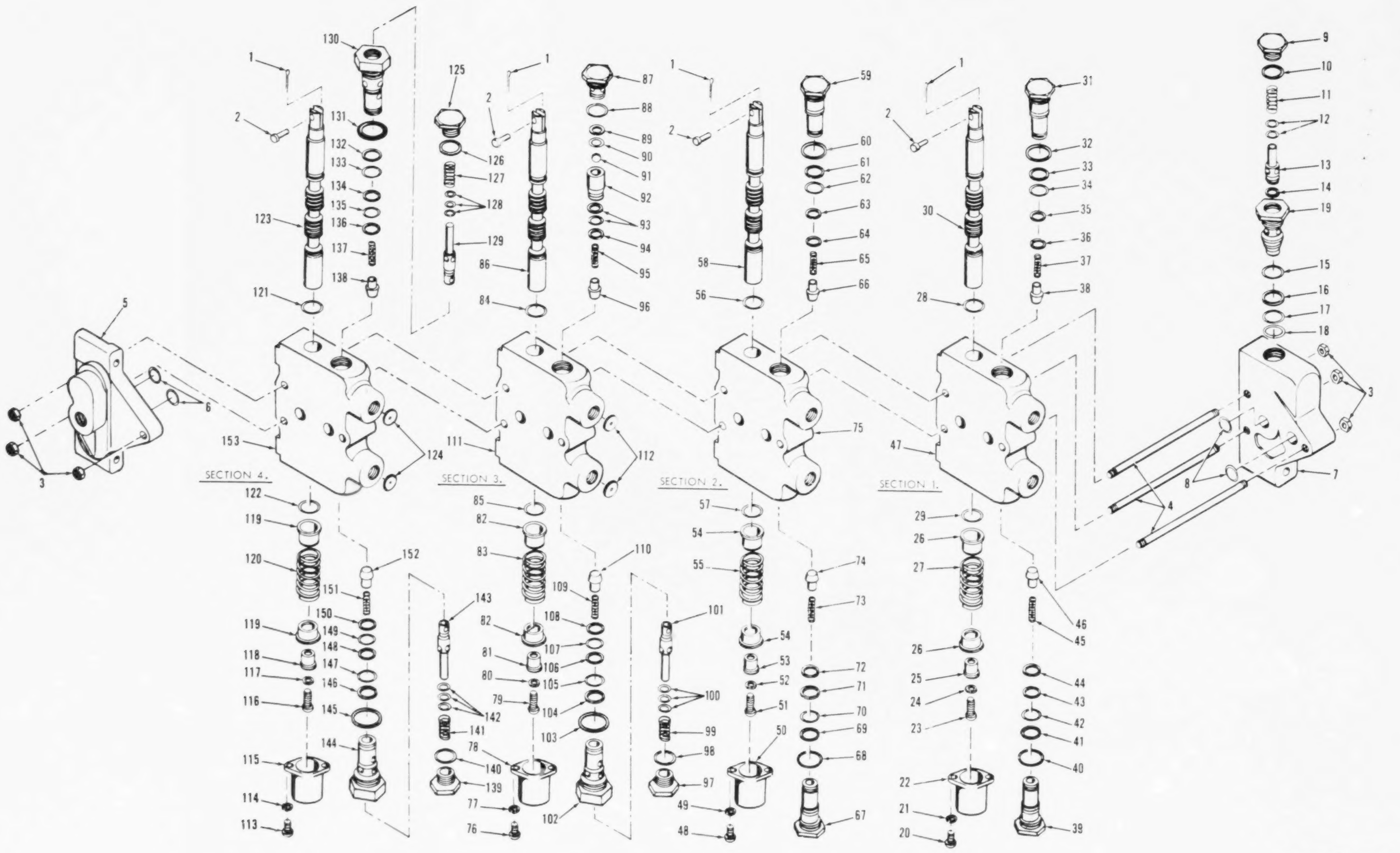


Figure 8-7. Four-way control valve assembly, exploded view.

1	Pin, cotter (4 rqr)
2	Pin, clevis (4 rqr)
3	Nut, stud (6 rqr)
4	Stud (3 rqr)
5	Cover
6	Packing, preformed (2 rqr)
7	Cover
8	Packing, preformed (2 r
9	Cap, relief valve
10	Packing, preformed
11	Spring
12	Shim (AR)
13	Poppet
14	Packing, preformed
15	Ring
16	Packing, preformed
17	Ring, back-up
18	Packing, preformed
19	Body (2 rqr)
20	Screw (2 rqr)
21	Washer, lock (2 rqr)
22	Bonnet
23	Screw
24	Washer, lock
25	Collar, spool
26	Collar, stop (2 rqr)
27	Spring
28	Packing, preformed
29	Packing, preformed
30	Spool
31	Plug, lift check
32	Packing, preformed
33	Washer, back-up (outer)
34	Packing, preformed (outer)
35	Packing, preformed (inner)
36	Washer, back-up (inner)
37	Spring, lift check
38	Poppet, lift check
39	Plug, lift check
40	Packing, preformed
41	Washer, back-up (outer)
42	Packing, preformed (outer)
43	Packing, preformed (inner)
44	Washer, back-up (inner)
45	Spring, lift check
46	Poppet, lift check
47	Housing section 1
48	Screw (2 rqr)
49	Washer, lock (2 rqr)
50	Bonnet
51	Screw
52	Washer, lock
53	Collar, spool
54	Collar, stop (2 rqr)
55	Spring
56	Packing, preformed
57	Packing, preformed
58	Spool
59	Plug, lift check
60	Packing, preformed
61	Washer, back-up (outer)
62	Packing, preformed (outer)
63	Packing, preformed (inner)
64	Washer, back-up (inner)
65	Spring, lift check
66	Poppet, lift check
67	Plug, lift check
68	Packing, preformed
69	Washer, back-up (outer)
70	Packing, preformed (outer)
71	Packing, preformed (inner)
72	Washer, back-up (inner)
73	Spring, lift check
74	Poppet, lift check
75	Housing section 2
76	Screw (2 rqr)
77	Washer, lock (2 rqr)
78	Bonnet
79	Screw
80	Washer, lock
81	Collar spool
82	Collar, stop (2 rqr)
83	Spring
84	Packing, preformed
85	Packing, preformed
86	Spool
87	Body, anti-cavitation chec
88	Packing, preformed
89	Packing, preformed
90	Washer, back-up (outer)
91	Ball
92	Retainer ball
93	Packing, preformed
94	Washer, back-up (inner)
95	Spring
96	Poppet
97	Cap, relief
98	Packing, preformed
99	Spring
100	Shim (AR)
101	Poppet, relief
102	Body, relief
103	Packing, preformed
104	Washer, back-up (outer)
105	Packing, preformed
106	Ring, piston
107	Washer, back-up (inner)
108	Packing, preformed
109	Spring
110	Poppet
111	Housing, section 3
124	Plate, orifice (.065)
113	Screw (2 rqr)
114	Washer, lock (2 rqr)
115	Bonnet
116	Screw
117	Washer, lock
118	Collar, spool
119	Collar, stop
120	Spring
121	Packing, preformed
122	Packing, preformed
123	Spool
124	Plate, orifice (.065)
125	Cap, relief
126	Packing, preformed
127	Spring
128	Shim (AR)
129	Poppet, relief
130	Body, relief
131	Packing, preformed
132	Washer, back-up (outer)
133	Packing, preformed
134	Ring, piston
135	Washer, back-up (inner)
136	Packing, preformed
137	Spring
138	Poppet
139	Cap, relief
140	Packing, preformed
141	Spring
142	Shim (AR)
143	Poppet, relief
144	Body, relief
145	Packing, preformed
146	Washer, back-up (outer)
147	Packing, preformed
148	Ring, piston
149	Washer, back-up (inner)
150	Packing, preformed
151	Spring
152	Poppet
153	Housing, section 4

Figure 8-7.